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Evidence of Play and Exercise in Early Pestalozzian and Lancasterian Elementary Schools in the United States, 1809--1845

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EARLY SCHOOLS have received inadequate recognition for their contribution to play and exercise in the development of physical education. Historians in this field[1] have established the Round Hill School as the place where the subject was first offered in the curriculum. They present meager evidence of earlier school play and give few details of schools in operation at the same time as the Round Hill School. This study is directed toward a more complete treatment of early evidence on the period 1809–1845, and in so doing the writer hopes to accumulate early play examples which show the development of thinking as well as practice.

Background of the Study

Play examples in this paper are limited to Pestalozzian and Lancasterian schools. Schools which were conducted by teachers formerly associated with Pestalozzi and which promoted his educational principles are referred to as Pestalozzian schools. Joseph Neef's school is the lone example prior to Civil War days. Lancasterian or monitorial schools are generally recognized as Joseph Lancaster's contribution to education. His efforts in England to educate large groups of children at minimal cost by using pupil monitors under one headmaster teacher developed a following for him in this country. That this school philosophy was widely copied is indicated by historical record. These schools, Pestalozzian and Lancasterian, represent two of several types of the times and this study expresses the view that schools of every type made significant contributions to the historical pattern of physical education in the United States.

Schools are termed elementary as they compare with modern elementary school attendance ages (6–12). Early schools falling into this category are more numerous than records would indicate, since many of the so-called academies were in reality elementary schools.[2] Inglis cited by Cubberley reports 6,085 such

[1] Fred E. Leonard, *A Guide to the History of Physical Education*, p. 237. Philadelphia: Lea and Febiger, 1927.

[2] Newton Edwards and Herman Richey, *The School in the American Social Order*, pp. 297–298. Boston: Houghton-Mifflin, 1947.

schools in the United States by 1850[3] which would indicate a formidable number despite the indiscriminate census counts of the day.

Limitations

The limiting dates of consideration in the study have been determined by two factors. The early date (1809) represents the earliest uncovered evidence of play in Neef's school near Philadelphia. The statement of Sheldon Davis[4] that monitorial school education received practically no attention in periodicals after 1845 has been used to set the later date at 1845.

Teacher participation or direction of pupil play and the relationship of play to the school program are two additional factors determining the number of schools considered. The recess period, for which supervision could not be established, is treated briefly.

Summary of the Findings

It is interesting to note some current opinions of the times concerning recess and the similarity to some modern school practices. The public schools of North-Borough, Massachusetts, adopted a regulation in 1831[5] allowing a ten-minute recess in the morning and another in the afternoon as relaxation from six hours of school. Lowell public schools in the same state adopted a similar regulation.[6]

One writer on recess disapproved the practice of confining children to one position for a lengthy period of time. The movement to and from classes in larger schools is described as useful for physical relief, but the one room schools needed ten-minute recesses at the end of every hour for "intellectual progress and physical well being."[7] Another view points out exercise as useful to pupils by "freeing the mind from common pursuits or studies. The mind as well as the body must be amused and exercised."[8]

Bronson Alcott refers to the scanty recess that is given every three hours in the public or common school and deplores the absence of enclosed playgrounds with direct provision for "particular or more favorable amusement." He excoriates the utilitarian views of those who reject sports and even devote the noon recreation hour to productive manual labor.[9]

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[3] Ellwood P. Cubberley, *Public Education in the United States*, p. 247. Boston: Houghton-Mifflin Co., 1934.

[4] Sheldon E. Davis, *Educational Periodicals During the Nineteenth Century*, p. 69. U. S. Bureau of Education Bulletin 28, 1919. Washington: Government Printing Office, 1919.

[5] Regulation for the Free Schools of the Town of North-Borough, Massachusetts, *American Annals of Education and Instruction*, II (July 1832), 384.

[6] Public Schools of Lowell, *American Annals of Education and Instruction*, V (May 1835) 221.

[7] Recesses, *Common School Journal of Pennsylvania*, I (1844) 55.

[8] Discussions on Physical Education, *American Annals of Education and Instruction*, VI (Nov. 1836) 494–499.

[9] Amusement a Part of Education, *American Annals of Education and Instruction*, VI (May 19, 1818) 91.

The Greene Street School of Providence, Rhode Island, announced recess when a card was pulled down, while order and stillness were demanded when the card was up. A bell was used on occasions. Entertainment was sometimes given during recess periods. Trained poodle dogs appeared on one program that required nearly one hour. Hiram Fuller was principal of this school in 1836.[10] From his association with Bronson Alcott through correspondence, one would suspect a progressive view toward play.

Joseph Neef, a former teacher with Pestalozzi, established a school for boys about five miles from Philadelphia in 1809.[11] From his early *Plan of Edcuation*[12] (1808) his views concerning gymnastics and exercise are known. He recognized the child's desire for bodily exercise such as running, climbing, swimming, bathing, jumping, skating, and sliding. He stressed the value of outdoor play as opposed to confined play and presented play and exercise as pleasure rather than toil. Calisthenics and military drill found a prominent place in his proposed plan.

The reported experiences of former students under Neef give evidence that his plans were translated into practice. C. D. Gardette relates how "Neef's boys" were recognized by the natives because of their appearance and vigorous outdoor life. The pupils were encouraged in all athletic sports and were accomplished swimmers, hikers, and gymnasts. Swimming was done in the Schuylkill River and Neef was an excellent swimming model to emulate. Exercise and play were taken in common with the teacher, and Mr. Gardette suggests that the teacher-pupil relations were so free as to be inconsistent with expected rapport between teacher and pupils. Activities were slanted toward those of "bodily vigor and adroitness." While military drill was emphasized, natural activities were given extensive time.[13]

A famous former pupil, David Glasgow Farragut of Civil War fame, in a statement reveals that he was taught swimming and climbing and was drilled like a soldier. He praised the school as rendering life-long values.[14]

The school remained about three years at the Falls of the Schuylkill and then moved to a small hamlet near Chester in Delaware County. It existed there for only a short time until Neef moved to Kentucky in 1816.[15] He was next employed at Robert Owen's New Harmony venture in Indiana in 1825 where manual labor and trades were substituted for the gymnastics and were con-

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[10] Henry L. Greene, *A Historical Sketch of the Greene Street School of Providence*, pp. 129–219. Rhode Island Historical Society Publication, New Series 6, January, 1898.

[11] Will S. Monroe, *History of the Pestalozzian Movement in the United States*, p. 97. New York: Bardeen, 1907.

[12] Joseph Neef, *Sketch of a Plan of Education, Founded on the Analysis of the Human Faculties and Natural Reason, Suitable for the Offspring of the Free People and for All Rational Beings*, pp. 102–110. Philadelphia: 1808.

[13] Pestalozzi in America, *Galaxy*, IV (August, 1867).

[14] Loyall Farragut, *Life of David Glasgow Farragut*, p. 49. New York: D. Appleton and Company, 1879.

[15] Monroe, *op. cit.*, p. 107.

sidered equally strengthening for the body.[16] In 1828 he returned to school teaching and conducted schools in Steubenville and Cincinnati, Ohio, for another six years.[17]

Monroe suggests that Neef's schools had little value in establishing and promoting the Pestalozzian methods in the United States.[18] However, present-day physical education with its emphasis on natural activities and, in many places attention divided between more formal type activities and natural ones, harks back to the former practices of Neef. The extensive curriculum, with its appreciation for children's desires for play, can also be seen in the early Pestalozzian schoolmaster's plans.

Some background information concerning monitorial school play and exercise can be learned from Joseph Lancaster's writings concerning his early English schools. The manual concerning the school at Southwark, England, is exemplary.[19] The financial statement of the school giving the cost of fill material for raising the school playground indicates Lancaster's concern for adequate play space.[20] He points out the value of playgrounds in attaching the child to the school, in keeping him off the streets, in establishing good morals, and in serving as a sanctuary for noon recreation for those pupils carrying their lunches.[21] Mrs. Trimmer in discussing Lancaster's plan of education mentions how pupils coming great distances to school spent one hour between morning and afternoon sessions in recreation such as tops, balls, races, and seasonal activities.[22]

Various numbers of toys such as bats, balls, and kites used as premiums for pupil achievement appeared in a financial report.[23] A paper currency of tickets was established by which tickets were given for merits. Two tickets were worth a paper kite, three a ball, four a wooden house, etc. The prizes were suspended above the master's head in the school room as visual incentives.[24]

Lancaster recognized pupils' irresistible disposition to action and the value of teacher cultivation of this tendency and subsequent diversion to useful purposes.[25] He defended the monitorial system as offering variation from the usual confinement at seats found in other schools and considers movement in his school as a safeguard to health.[26]

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[16] Mr. Owen's School at New Harmony, *American Annals of Education and Instruction*, I (June, 1826) 377.

[17] Monroe, *op. cit.*, p. 117.

[18] Monroe, *op. cit.*, p. 125.

[19] Joseph Lancaster, *Improvements in Education as It Respects the Industrial Classes of the Community, Borough Rd., Southwark.* London: Darton and Harvey, 1805.

[20] *Ibid.*, p. 13.

[21] *Ibid.*, p. 17.

[22] Mrs. Trimmer on Lancaster's Plan of Education, *Edinburgh Review*, IX (October, 1806) 179.

[23] Lancaster, *op. cit.*, p. 19.

[24] Joseph Lancaster, Outlines of a Plan for Educating 10,000 Poor Children by Establishing Schools in Country, Towns and Villages and for Uniting Works of Industry with Useful Knowledge, *Edinburgh Review*, (October, 1807–January, 1808) 61–73.

[25] Lancaster, *Improvements in Education as it Respects the Industrial Classes of the Community, op. cit.*, p. 31.

[26] *Ibid.*, p. 188.

The monitors in the school were in charge of marching their group to and from various school work stations. They were instructed in proper voice inflection in giving commands to prevent overly authoritative tones which could create ill feelings between fellow students and their monitors.[27] The monitor was also charged with checking attendance. This was done by numbering the group members and then reporting absences to the master.[28] These practices do not seem too far removed from practices in present-day physical education classes. Squad leaders are the modern monitors.

Evidence of the curricular experiences in the early monitorial schools in the United States is not recorded as abundantly as the commentary of the establishment of schools of this type. However, some evidence is drawn from the British and Foreign School Society Manual which was used as a guide for schools in this country and especially printed for the Philadelphia Society for the Establishment and Support of Charity Schools.[29]

In this early manual, a playground or yard was deemed desirable as a place for children to gather before they went into school and as a place to spend the hours of recreation. The soil of the yard was to be sand to a depth of one foot and the yard was to be enclosed by a wall of appropriate height.[30] In the Manual of 1820,[31] which closely resembled its British prototype, reference is made to the use of a whistle by the Monitor General to stop an activity. This incident is inserted to point out an early use of the whistle in school and to suggest that the use of the whistle in physical education to-day, while filling a definite need, may well be a carry over from formalistic monitorial methods. A later manual listed "recess and oral" instruction in the daily order of school exercises as of fifteen-minute duration. The pupils went to the playground and were allowed free play or "little amusing games or exercises under the direction of the teacher."[32]

John Pickett in the *Academician* defends the use of children as monitors as very plausible for teaching other children. The analogy of children teaching others in play and popular games such as chicken, fox and geese, tit-tat-toe, and hop-skip-and-jump is made to the teaching of other knowledge. He insists that if the child is capable of teaching amusements and play he is able to teach knowledge of the branches of learning. He does not overlook the problem of exciting the interest in studies as contrasted to the ease of stimulation in play.[33]

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[27] *Ibid.*, p. 107–108.

[28] *Ibid.*, p. 111–112.

[29] Benjamin Warner, *Manual of the System of Teaching Reading, Writing, Arithmetic and Needlework in the Elementary Schools of the British and Foreign School Society* (First American Edition) 1817.

[30] *Ibid.*, p. 1.

[31] *Manual of the Lancasterian System of Teaching Reading Writing and Arithmetic and Needlework as Practiced in the Schools of the Free School Society of New York*, as quoted in John F. Reigart, *The Lancasterian System of Instruction in the Schools of New York City*, p. 37. New York: Teachers College, Columbia, Univ., 1916.

[32] *Manual of the System of Discipline and Instruction for the Schools of the Public School Society of New York, Instituted in 1805*, p. 121. New York, 1850.

[33] "The New School or Lancasterian System", *Academician*, I (May 19, 1818) 91.

The continual occupation of pupils in school tasks, supplemented by military marching to and from activities, as in the earlier Lancasterian schools, was considered as contributing to the physical well-being of the child. Roberts Vaux's Tenth Annual Report of the Controllers of Public Schools[34] gives attendance figures of the ten monitorial schools of the First School District of Pennsylvania, and indicates that girls were taught sewing, knitting, and needlework on canvas in addition to the branches of learning. These activities are not pointed out here as play or exercise but as another indication of the adoption of Lancaster's earlier school practices from England. From all indications there was little or no difference in the early American Lancasterian school in respect to play and exercise from its English counterpart. The tendency toward a school of activity, along with the insistence that a playground is a standard school plant facility, would indicate a readiness for curriculum development in that area.

The monitorial high schools, established in the second decade of the nineteenth century, furnish much more evidence of curricular experiences in physical education. Although called high schools, most schools accommodated children of elementary ages. The Boston Monitorial School for Girls was opened October 14, 1823[35] in Washington Court and was in operation under William Bentley Fowle with pupils ranging from ages four to eighteen. Mr. Fowle's experiences of introducing gymnastic exercises into the school are most informative.[36] After attending a lecture by Doctor Coffin in 1825, Mr. Fowle read all available material on the subject and was deeply impressed but not deterred by the discouragement set forth concerning exercise for the "weaker sex."

From the description of the apparatus set up in the play area, the gymnastic high bar is recognized. Activities were planned for all children during the recess periods and play hours. Besides calisthenics, hanging and swinging from bars, tilting, raising weights, jumping forward (broad jump), marching, running, and endurance were practiced.[37] Fowle concluded that taking exercise with the children does not lessen pupil respect but did lessen the skin on his hands which were blistered for his efforts. His appraisal of outcomes of exercise sounds like modern-day physical education objectives. He mentions "character building, strengthening of the weak and feeble, animation of the dull pupils, reducing overexuberant spirits in school, sustaining discipline," and, as previously mentioned, retaining pupil respect for the participating teacher.[38] Mr. Coffin characterized the experiment as the first successful gymnastics practiced in the United States with girls.[39]

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[34] Roberts Vaux, "Tenth Annual Report of the Controllers of Public Schools", *The Register of Pennsylvania*, I (March 8, 1828) 155.

[35] A Biographical Sketch of William Bentley Fowle, *American Journal of Education*, X (1861) 597–610.

[36] William Fowle, The Animal Mechanism and Economy, *Boston Medical Intelligencer*, IV (Oct. 24, 1826) 196–197.

[37] *Loc. cit.*

[38] *Loc. cit.*

[39] John G. Coffin, *Boston Medical Intelligencer*, IV (October 24, 1826) 197 (editor's comment).

The New York High School was opened March 1, 1825, with an enrollment of 250 boys under the guidance of John Griscom. The Introductory, Junior, and Senior were the three departments of the school which at full complement would accommodate 650 boys.[40] Mr. Griscom's address at the school opening expressed willingness "to admit children who are able to walk, pronounce with distinction, and aware of events about them."[41] He devoted considerable time to his intention to include gymnastics in the program and gave the values of the activity as expressed in a letter to a medical friend in London.

Mr. Griscom anticipated finding boys in the school who would be willing and qualified to instruct others in leaping, climbing, pitching, and other varieties of muscular skill and exertion.[42] In the closing comments of the address, he stated that, in other schools, problems and instructional duties had hindered doing much toward the completion of the plans for gymnastic exercise.[43]

His aspirations evidently materialized two years later according to his Second Annual Report to the Trustees,[44] January, 1827. In this report he related the inclusion of gymnastics under the supervision of an experienced and careful teacher and cited the results as a distinct advantage to the "spirit and health of the students." The school was continued until near the close of the year 1831.[45]

Modeled after the New York High School, the Buffalo High School, as described in the prospectus, was to include a branch for girls in addition to the three departments for boys. Gymnastics were mentioned in the program outline of each of the three departments.[46]

The Livingston County High School at Temple Hill, one-half mile from Genesee, New York, was advertised[47] to open December 1, 1827, under the direction of three Harvard graduates and planned as the New York High School. In operation, "health, physical vigor, and gymnastics" were stressed.[48]

The Berkshire High School at Pittsfield, Massachusetts, was to be opened June, 1828, with 96 pupils. The advertisement promised gymnastics, botanical, and mineralogical excursions and various means to secure "vigor and energy of back and mind."[49] Utica, New York, opened a high school with a connected

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[40] John H. Griscom, *Memoirs of John Griscom*, New York: Robert Carter and Brothers, 1859, p. 207.

[41] John Griscom, *Monitorial Instruction: An Address at the Opening of the New York High School*, Mahlon Day, 1825.

[42] *Ibid.*, pp. 54–57.

[43] *Ibid.*, pp. 207–208.

[44] Second Annual Report to Trustees, *American Annals of Education and Instruction*, II (1827) 58–60.

[45] John H. Griscom, *Memoirs of John Griscom*, *op. cit.*, p. 207.

[46] Buffalo High School, *American Annals of Education and Instruction*, III (April 1828) 233–235.

[47] Livingston High School, *American Annals of Education and Instruction*, I (July 1826) 441.

[48] Livingston High School, *American Annals of Education and Instruction*, II (Nov. 1827) 700–701.

[49] Berkshire High School, *American Annals of Education and Instruction*, II (May 1827) 316–317.

gymnasium in 1827.[50] A high school at Bridgeport, Connecticut, similar to the New York High School in administration, was founded in 1827 with two departments, one for boys and the other for girls.[51]

Another school that should be considered in this general group is Mr. Gideon Thayer's Chauncy Hall School at Chauncy Place, Boston. The teacher furnished information concerning the school to the *American Annals of Education and Instruction* under the date of June 15, 1826.[52] Although the school is considered by many to be an academy-type institution, reference was made on several occasions to the use of monitors in spelling dictation and attendance recording.[53]

Boys moved in lines from school to the gymnastic area with play apparatus. In favorable weather fifteen minutes were spent in running, hopping, jumping with poles (vaulting), leap frog, and tug-o-war. A balance beam is mentioned as apparatus used in exercising. Exercises were held in the school yard when the weather was suitable. Plans had been laid to add to the apparatus available in the immediate play area. When one class returned from the exercise area, another teacher took the remaining students to the play field. Marching was conducted in the school and posture checks were made. "Carriage of the body, turning the toes outward and the common faults of posture" were evaluated. Besides the daily exercises, there were occasions when assistants met boys at the play area early in the morning for sports activities or hiking.

Play was offered only to those pupils proficient in studies and deportment during the morning. The modern school which deprives pupils from play opportunities due to lack of acceptable behavior evidently had an early precedent in the Chauncy Hall School. The children attended school from age seven to fourteen. The earliest date of the school was 1820 when two pupils comprised the enrollment which was increased to 60 pupils in 1823. The staff was made up of four teachers.[54]

Conclusions

An appraisal of the early schools of Pestalozzian and Lancasterian derivation brings out many and varied instances of play and exercise. That these schools served as foundation stones for future educational programs is not generally accepted in view of the history of education which finds Pestalozzian schools a post-Civil War movement and the Lancasterian school a prewar casualty. However, the reasoning that play and exercise as a part of these schools likewise have no fundamental value and example for the schools of the future should not necessarily follow.

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[50] Utica High School, *Boston Medical Intelligencer*, V (Sept. 25, 1827) 311.

[51] Bridgeport High School, *American Annals of Education and Instruction*, III (August, 1828) 489.

[52] Mr. G. F. Thayer's School, *American Annals of Education and Instruction*, I (Aug. 1826) 508–509; (Sept. 1826) 561–564.

[53] *Ibid.*, p. 509, 561.

[54] *Loc. cit.*

Modern physical education has many practices analogous to the early schools. Although these practices cannot be established as an influence of a major degree, they do have the advantage of primacy of use. Neef's use of natural activities such as swimming and skating, if appearing in the beginning of the twentieth century, would have been pioneer groundwork to our present return to natural activities. The monitorial schools with a combination of games and more formalistic activities would compare favorably with many modern programs. The emphasis to adjoin playgrounds to school buildings, the use of specific activities such as balance beams, tit-tat-toe, tug-o-war, the formal monitorial attendance-taking and teaching methods still in vogue in the squad leader technique, playing privileges in exchange for compliance to teacher expectancies, marching as an activity, the use of the whistle, girl participation in play activities, teacher-pupil participation, and apparatus exercises are some of the early practices reflected in physical education today. The reflection may be dim, blurred, or very clear, but irrespective of the nature of the reproduction, the early schools must be recognized as an authentic historical ancestor of modern physical education.

Sources

The University of Michigan Main Library and the State Library at Harrisburg, Pennsylvania, provided the primary source material for this study. The great volume of evidence in this paper focused on the states of Pennsylvania and New York since they were the prominent advocates of the Lancasteran schools. Reference is made less frequently to the New England states. In most cases the various early editors of the *American Annals of Education and Instruction* provided the information.

New Objective Strength Tests of Muscle Groups by Cable-Tension Methods[1]

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Theodore L. Bailey
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Over a period of several years, apparatus and objective techniques have been devised for measuring the strength of muscles activating movements of the joints of the body. Originally, 28 tests were proposed based on certain movements of the wrist, elbow, shoulder, hip, knee, and ankle.[2] Many of these tests have since been revised and the number reduced to 22.[3] Intended to measure the strength of muscles involved in orthopedic disabilities, the tests have been constructed under subsidy from the Office of Naval Research.

In this report, the construction of 16 new strength tests is described. Movements of the fingers, thumb, neck, and trunk are included, as well as additional movements of the wrist, shoulder, and ankle. New findings pertaining to four of the previously reported hip tests are also given.

Testing Equipment

Pulling Assemblies. In this type of objective strength testing, a specially adapted and calibrated aircraft tensiometer is utilized to record the amount of tension the subject can apply to a cable appropriately placed for specified movements. A homemade pulling apparatus was devised and was described in the 1948 report by Clarke. Subsequently, however, this apparatus was simplified by the use of a short piece of cable attached to a welded link ($1\frac{1}{2}$ x $\frac{1}{2}$) chain, thus eliminating the adjuster bar and assembly. A double harness snap, over all length of four inches, was substituted for the former loop. (See Figure I.)

It became necessary in the construction of the new tests to devise special pieces of equipment to be used with those already available for cable-tension strength testing. This equipment consisted of three different straps, an upper trunk harness, and an arm-rest chair. Illustrations of certain of these items appear in Figure I.

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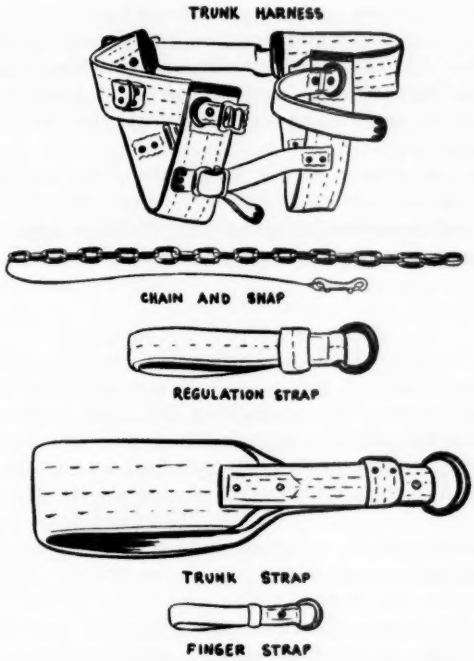
[1] Acknowledgement is made particularly to Edwin H. Richardson for his work in the initial study of these tests. Appreciation is also expressed to many other graduate students at Springfield College who subsequently contributed to their further development.

[2] H. Harrison Clarke, Objective Strength Tests of Affected Muscle Groups Involved in Orthopedic Disabilities, *Research Quarterly*, **19**, 4 (May 1948), pp. 118–47.

[3] H. Harrison Clarke, Improvement of Objective Strength Tests of Muscle Groups by Cable-Tension Methods, *Research Quarterly*, **21**, 4 (Dec. 1950), pp. 399–419.

FIG. 1



PULLING ASSEMBLIES

1. *Finger strap.* This strap was made from 1-inch, 3-ply belting, 20 inches long. It was folded back on itself, riveted at the free end to hold a one-inch D-ring and then stitched to secure the rivet. A keeper was made out of the same material, folded twice around for stiffness and riveted.

2. *Trunk strap.* A wide strap was designed for upper-trunk testing. The pieces of belting were 5 x 30 inches and 2 x 30 inches. The construction of the strap was similar to the head strap and had a similar keeper.

3. *Trunk harness.* The upper trunk harness had the following pieces of webbing: two shoulder straps, each 3 x 24 inches; two under-arm straps, each 3 x 12 inches; and four adjustable straps (two in front and two in back), each 16 inches of $1\frac{1}{4}$-inch cotton-web or $1\frac{1}{2}$-inch luggage belting. Each shoulder strap was securely sewed at slightly acute angles to each end of an under-arm strap. The rough corners were bound with leather to prevent fraying.

All buckles for adjustable straps were attached to the right shoulder strap. The upper buckles were placed five inches from the midpoint of the strap: one for the chest and one for the back. The lower buckles were attached over the junction of the shoulder and under-arm straps. Adjustable, serrated, lip-type buckles, $1\frac{5}{8}$-inches wide, were used. The adjustable straps were attached to the left shoulder piece, directly opposite the buckles.

The buckles were fastened to the shoulder strap by a 2-inch piece of belting. At the midpoint of each under-arm strap, a 1-inch D-ring was attached.

4. *Arm-rest chair.* A school-type chair with a short writing board was adapted for the tests of the fingers, thumb, and wrist. A $\frac{3}{8}$-inch hook was placed in the right front leg of the chair about six inches from the floor, and slanted in line with the angle of pull.

5. *Testing table.* In order to permit attachment of the pulling assembly directly below the subject in trunk and hip tests, a slit 20″ x 7″ was cut lengthwise in the center of the testing table, beginning 10 inches from one end. Appropriate hooks for attaching the pulling assembly were placed in a frame under the table.

Procedures

Alternate Test Positions. The initial selection of body position for these new strength tests was based on available literature regarding the anatomical, kinesiological, and mechanical functions of the joint movements involved. Insofar as possible, the positions were patterned after those used by physical medicine in manual muscle testing. Every effort was made to isolate the specific muscles in a joint movement, thus eliminating the effect of extraneous muscles.

After some experimentation with these techniques and following an extensive review of the tests by consultants on physical medicine at the Mayo Clinic,[4] alternate positions for four trunk, four hip, and two ankle tests were suggested in order to provide improved kinesiological action of the muscles involved. Particularly important for the trunk and hip tests was the suggestion to cut the slit in the table so that the pulling assembly could be attached directly beneath the subject. As a consequence, the subject could be placed in a lying position permitting the muscles around the hip joint to be on greater stretch.

As the proposals for change required experimentation, the subjects were tested in both the original and suggested positions. For each test, the means of the tensions applied in each position were computed for the subjects, who were 64 non-disabled male students at Springfield College. The difference between the means were tested for significance in accordance with the null hypothesis based upon "student's" distribution.[5] On this basis, *t*-values of 1.67 and 2.37 denote significance for the number of cases involved at the .05 and .01 levels of confidence respectively. These values for *t* were chosen because, in this study, significance was measured from zero, or no difference, in a positive direction only. In explanation, when the hypothesis tested postulates a difference in one direction only, the probability yielded by *t* as given in ordinary tables is halved.

The tests, the positions studied, and the results obtained for this phase of the study appear below. In the test positions described, the cable was always

[4] Drs. Earl C. Elkins, Gordon M. Martin, and Khalil G. Wakim.

[5] R. A. Fisher, *Statistical Methods for Research Workers.* Tenth Edition. London: Oliver and Boyd, Ltd., 1946, p. 118; and Henry E. Garrett, *Statistics in Psychology and Education.* Third Edition. New York: Longmans, Green and Company, 1947, p. 203.

arranged at right angles to the body part acting as fulcrum. Zero degrees is a position away from the median line of the body; and 180 degrees parallels and is toward the median line.

In certain of the trunk and hip tests, parts of the body were lifted in performing the tests, the weights of which, of course, were not included in the tensiometer readings. Although it is not known from this experiment the amount of strength expended in lifting the trunk or a leg, a rough measure of this weight was obtained in the following manner: The body was placed in position for the test; the part lifted was suspended in the pulling apparatus with the strap located at the pulling point, right angles to the part; and the amount of tension applied to the cable was determined. In the following study of joint positions, this amount, known as the "gravity factor," was added to or subtracted from test scores as indicated.

1. *Trunk flexion.* In the original form, the subject sat on a chair, trunk and thighs forming a right angle; hips and knees were braced with feet flat on floor; arms were folded on chest. In the alternate form, the subject was in supine lying position; thighs in 180 degrees extension and adduction; knees in 180 degrees extension; arms folded on chest.

The mean for the original form of the test was 126.68 pounds; and for the alternate form, 226.21 pounds (gravity factor added), an increase of 99.53 pounds, or 78 per cent. The t was 18.47, indicating a statistically significant difference.

2. *Trunk extension.* The original form of this test was the same as for trunk flexion; the same is true for the alternate form, except that the subject was in prone lying position with hands folded over small of back.

The mean for the original of the test was 234.66 pounds; and for the alternate form, 271.20 pounds (gravity factor added), an increase of 36.54 pounds, or 16 per cent. The t was 4.48, indicating a statistically significant difference beyond the .01 level of confidence.

3. *Trunk lateral flexion.* In the original form of this test, the subject was in prone lying position, legs extended, arms at side. In the alternate form, the subject was lying on side, legs together and extended; under arm was placed through slit in plinth and upper arm rested on his side.

The mean for the original form of the test was 159.19 pounds; and for the alternate form, 220.08 pounds (gravity factor added), an increase of 60.89 pounds, or 38 per cent. The t was 21.67, indicating a statistically significant difference.

4. *Trunk rotation.* In both the original and the alternate forms, the subject was in supine lying position with legs flexed (and held firmly by the tester); arms were folded over chest. The difference in the testing was in location of pulling assembly: in original position, it was stretched between the chest D-ring of trunk harness and a hook on the wall; in alternate position, it was stretched between the D-ring on side of harness and to hook beneath subject.

The mean for the original form of the test was 35.97 pounds; and for the alternate form, 44.06 pounds, an increase of 8.09 pounds, or 23 per cent. The t

was 5.58, indicating a statistically significant difference beyond the .01 level of confidence.

5. *Hip flexion.* In the original position, the subject was sitting at end of table leaning backward with arms extended to rear and hands grasping sides of table, legs hanging free; hip on side of thigh being tested flexed to 90 degrees, knee in 90 degrees flexion. In the alternate form, the subject was in supine lying position with leg being tested extended and opposite leg in comfortable flexed position; arms folded across chest.

The mean for the original form of the test was 108.88 pounds (gravity factor added); and for the alternate form, 207.19 pounds (gravity factor added), an increase of 98.31 pounds, or 90 per cent. The *t* was 19.70, indicating a statistically significant difference.

6. *Hip extension.* In the original form, the subject was in supine lying position, free leg flexed at knee with foot resting on table, arms folded on chest; thigh being tested was flexed at hip to 90 degrees, knee flexed with angle unspecified. In the alternate form, the subject was in prone lying position with legs extended and arms along side of body.

The mean for the original form of the test was 174.90 pounds (gravity factor subtracted); and for the alternate form, 224.17 pounds (gravity factor added), an increase of 49.27 pounds, or 28 per cent. The *t* was 7.66, indicating a statistically significant difference.

7. *Hip adduction.* In the original form, the subject was in supine lying position, arms folded on chest; thigh being tested was adducted at hip to 160 degrees. In the alternate position, the subject was in side lying position; pulling assembly passed through slit in table.

The mean for the original position was 111.60 pounds; and for the alternate position, 166.38 pounds (gravity factor added), an increase of 54.78 pounds, or 49 per cent. The *t* was 16.70, indicating a statistically significant difference.

8. *Hip abduction.* For this test, both the original and alternate forms were essentially the same as for hip adduction.

The mean for the original form was 108.56 pounds; and for the alternate form, 200.10 pounds (gravity factor added), an increase of 91.54 pounds, or 84 per cent. The *t* was 17.67, indicating a statistically significant difference.

9. *Ankle inversion.* In the original form, the subject sat at end of plinth, hands grasping sides of plinth; heel of foot being tested was placed firmly in slot of specially constructed foot rest. In the alternate, the subject was in supine lying position, knee of free leg flexed comfortably, arms folded on chest; leg of ankle tested was fully extended with ankle in 90° plantar flexion.

The mean for the original form was 38.69 pounds; for the alternate form, 38.25 pounds. The difference between the means was .44 pounds. The *t* was .33, indicating that the difference is not statistically significant. Inasmuch as the special foot rest could be eliminated, however, the revision was accepted.

10. *Ankle eversion.* For this test, both the original and alternate forms were the same as for ankle inversion.

The mean for the original form was 30.53 pounds; for the alternate form, 31.25 pounds. The difference between the means was .72 pounds. The *t* was .68,

indicating that the difference is not statistically significant. Again, inasmuch as the special foot rest could be eliminated, the revision was accepted.

Precision Study. The purpose of this phase of the research was to determine the degree of precision of the various strength tests studied. Objectivity coefficients[6] for each of the tests was determined as applied to 64 non-disabled male students at Springfield College. A number of testers participated in the collection of the data. Each test was administered twice to the same subjects during a single testing period.

Following the testing, a product-movement coefficient of correlation was computed between the two scores obtained by the different testers. The resultant correlations appear in Table 1, and are herein known as objectivity coefficients. As .90 indicates desirable objectivity and as tests with coefficients as low as .80 may be used for individual measurement, only two of the tests (thumb adduction, wrist abduction) have questionable objectivity. The following four other tests, however, were found to be below the desired coefficient of .90: forefinger extension, ankle inversion, hip abduction, and hip adduction (.89).

TABLE 1

Objectivity coefficients of 20 strength tests studied

Joint Area	Name of Test	Objectivity Coefficients		
Hand and wrist	1. Finger flexion	.90		
	2. Finger extension	.93	.76	.81
	3. Thumb abduction	.91		
	4. Thumb adduction	.84	.75	.56
	5. Wrist abduction	.84	.66	.74
	6. Wrist adduction	.91		
Shoulder	7. Shoulder horizontal flexion	.93		
Neck	8. Neck flexion	.93		
	9. Neck extension	.92		
	10. Neck lateral flexion	.97		
Trunk	11. Trunk flexion	.90		
	12. Trunk extension	.99		
	13. Trunk lateral flexion	.90		
	14. Trunk rotation	.97		
Hip	15. Hip flexion	.90		
	16. Hip extension	.94		
	17. Hip abduction	.82		
	18. Hip adduction	.89		
Ankle	19. Ankle inversion	.86		
	20. Ankle eversion	.92		

Considerable difficulty was encountered in securing proper objectivity for tests of the weaker muscle groups, including the finger, thumb, and wrist movements. In these instances, the range of scores was so small that minor fluctuations in the results of the two tests on each subject resulted in relatively larger changes in the scattergrams from which the correlations were computed.

[6] In physical testing, a measure is considered objective if two or more testers, using the same instruments and applying the same techniques secure similar results.

Test Descriptions

Descriptions of the cable-tension strength tests included in this study appear below. Drawings illustrating the tests appear at the end of the article.

In the following tests the weight of parts of the body is lifted in performing the movement: the head in neck flexion, extension, and lateral flexion; the trunk in trunk flexion, extension, and lateral flexion; and the leg in hip flexion, extension, abduction, and adduction. To record roughly the actual weight lifted by the muscles in these tests, the gravity factor (weight of the part in test position) may be added to the test score.

Tests of Hand and Wrist Joints

1. FINGER FLEXION (Illustrated)
   Starting Position
   (a) Subject sitting in arm-rest chair; feet on floor; free arm resting comfortably on thigh.
   (b) Forearm and hand on side tested supinated and resting on writing board; towel placed under arm and hand for comfort.
   (c) Line of metacarpal-phalangeal joints at edge of writing board; finger being tested extended beyond 180 degrees.
   Attachments
   (a) Finger strap placed around first phalanx of forefinger.
   (b) Cable attached to hook on front leg of chair; adjust so that forefinger "pulls into" straight line with forearm when testing.
   Precautions
   (a) Prevent palmar flexion and elbow flexion by bracing.
2. FINGER EXTENSION (Illustrated)
   Starting Position
   (a) Subject sitting in straight chair; feet on floor; free arm resting comfortably on thigh.
   (b) Shoulder on side tested in 180 degrees extension and adduction; forearm and hand pronated lying flat on arm rest of another chair; forefinger just off edge of arm rest, flexed to 80 degrees.
   Attachments
   (a) Finger strap placed around first phalanx of forefinger.
   (b) Pulling assembly attached to wall at rear of subject.
   Precautions
   (a) Prevent wrist dorsal flexion and elbow flexion by bracing.
   (b) Prevent thumb from interfering by having subject extend it.
3. THUMB FLEXION (Illustrated)
   Starting Position
   (a) Subject sitting in arm-rest chair; feet on floor; free arm resting comfortably on thigh.
   (b) Forearm on side tested in mid-prone-supine position; thumb abducted to maximum; fingers extended.
   Attachments
   (a) Strap placed around interphalangeal joint of thumb.
   (b) Pulling assembly attached to wall at rear of subject, directly in the line of pull.
   Precautions
   (a) Prevent abduction and elevation of shoulder.
   (b) Keep wrist and fingers fully extended by bracing.
4. THUMB EXTENSION (Illustrated)
   Starting Position
   (a) Subject sitting in arm-rest chair; feet on floor; free arm resting comfortably on thigh.

(b) Forearm on side tested in mid-prone-supine position; side of hand resting on writing board far enough forward to allow thumb attachment; fingers extended; thumb extended to be in line with forefinger at height of pull (place pad under wrist for comfort).

Attachments

(a) Strap placed around proximal phalanx of thumb.
(b) Pulling assembly attached to chair-leg hook.

Precautions

(a) Prevent abduction and elevation of shoulder.
(b) Keep fingers and wrist fully extended by bracing.

5. WRIST ABDUCTION (Illustrated)

Starting Position

(a) Subject sitting in arm-rest chair; feet on floor; free arm resting comfortably on thigh.
(b) Upper arm on side tested adducted and extended at shoulder; forearm pronated; hand flat on writing board (talcum may be used on writing board to prevent friction).

Attachments

(a) Strap placed around metacarpal-phalangeal joints.
(b) Pulling assembly attached to wall at side being tested.

Precautions

(a) Stabilize arm and elbow by bracing with hip.
(b) Prevent tilting of chair and leaning of body.
(c) Prevent movement of forearm by bracing.

6. WRIST ADDUCTION

The position for this test is the same as for WRIST ABDUCTION. The pulling assembly, however, is attached to the opposite side.

7. SHOULDER HORIZONTAL FLEXION (Illustrated)

Starting Position

(a) Subject in supine lying position; hips in 180 degrees extension and adduction; knees fully extended; free arm across chest.
(b) Arm on side tested flexed at shoulder to 90 degrees; elbow flexed to 90 degrees; forearm directed across body in mid-prone-supine position.

Attachments

(a) Strap placed around arm midway between elbow and shoulder joints.
(b) Pulling assembly attached to wall at side away from body.

Precautions

(a) Prevent trunk from lateral flexion and shoulders from lifting by bracing.
(b) Steady subject's arm in testing position by holding.

8. NECK FLEXION (Illustrated)

Starting Position

(a) Subject in supine lying position, hips and knees flexed; feet and elbows resting on table; hands folded on chest.
(b) Occipital lobe of head resting on edge of table.

Attachments

(a) Strap placed over supra-orbital ridge and forehead (use pad over forehead and bridge of nose for comfort).
(b) Pulling assembly attached below head.

Precautions

(a) Require subject to tuck his chin in when pulling.
(b) Prevent hunching of shoulders.

9. NECK EXTENSION (Illustrated)

Starting Position

(a) Subject in prone lying position; legs extended; forearms dangling over edge of table (use pad under clavicle and manubrium areas of chest and shoulders for comfort).

(b) Rest chin on edge of plinth.
Attachments
(a) Strap placed over occipital lobe of head.
(b) Pulling assembly attached below head.
Precautions
(a) Insure 0-degree position of head when pulling.
(b) Prevent lifting of chest by bracing.

10. NECK LATERAL FLEXION (Illustrated)
Starting Position
(a) Subject in side-lying position close to table edge; under arm extended to help support head; under leg flexed at hip and knee; upper leg extended.
(b) Head extended far enough over end of table to permit strap placement.
Attachments
(a) Strap over head diagonally from forehead to occipital lobe.
(b) Pulling assembly attached below head.
Precautions
(a) Stabilize trunk and shoulders so that shoulders are in vertical line by bracing.

11. TRUNK FLEXION (Illustrated)
Starting Position
(a) Subject in supine lying position; hips in 180 degrees extension and adduction; knees fully extended; arms folded on chest.
Attachments
(a) Trunk strap placed around chest, close under arm pits.
(b) Pulling assembly attached beneath subject.
Precautions
(a) Prevent lifting of hips by bracing.

12. TRUNK EXTENSION (Illustrated)
This test is performed in the same manner as TRUNK FLEXION except subject is in prone lying position with hands clasped behind back. The hips are prevented from lifting by bracing.

13. TRUNK LATERAL FLEXION (Illustrated)
Starting Position
(a) Subject in side-lying position; hips in 180 degrees extension and adduction; knees in 180 degrees extension; lower arm placed through slit in plinth and other arm resting at side; head placed on small pad for comfort.
Attachments
(a) Trunk strap placed around chest, close under arm pits.
(b) Pulling assembly attached beneath subject.
Precautions
(a) Prevent lifting hips by bracing.
(b) Maintain lateral plane of body perpendicular to plinth.
(c) Be sure hand through slit in plinth remains free hanging.

14. TRUNK ROTATION (Illustrated)
Starting Position
(a) Subject in supine lying position close to edge of plinth; hips in 180 degrees extension and adduction; knees fully extended; arms folded on chest.
Attachments
(a) Trunk harness is strapped firmly to subject.
(b) Pulley assembly snapped to D-ring on side of harness; and attached below subject.
Precautions
(a) Prevent lifting hips by bracing.
(b) Do not permit trunk lateral flexion.

15. HIP FLEXION (Illustrated)
Starting Position
(a) Subject in supine lying position; hip and knee of free leg flexed with foot resting on table; arms folded on chest.
(b) Hip and knee of leg being tested extended and adducted to 180 degrees.

Attachments
(a) Strap placed around thigh, lower third between hip and knee joints.
(b) Pulling assembly attached beneath subject.
Precautions
(a) Prevent lifting of shoulders by bracing.

16. HIP EXTENSION (Illustrated)
Starting Position
(a) Subject in prone lying position; hips in 180 degrees extension and adduction; knees fully extended; arms extended along sides of body.
Attachments
(a) Strap placed around thigh, lower third between hip and knee joints.
(b) Pulling assembly attached beneath subject.
Precautions
(a) Prevent lifting of hip by bracing.

17. HIP ABDUCTION (Illustrated)
Starting Position
(a) Subject in side-lying position; lower knee flexed to approximately 70 degrees to permit passage of strap; lower arm extended for head rest; upper arm resting on side with elbow flexed in comfortable position.
(b) Hip of upper leg in 180 degrees extension and adduction; knee fully extended.
Attachments
(a) Strap placed around thigh, lower third between hip and knee joints.
(b) Pulling assembly attached beneath subject.
Precautions
(a) Prevent lifting of shoulders and hips by bracing.
(b) Maintain lateral plane of body perpendicular to plinth.
(c) Prevent left leg from interference with strap and movement.

18. HIP ADDUCTION (Illustrated)
Starting Position
(a) Subject in side-lying position; lower arm extended for head rest; upper arm resting on side with elbow flexed in comfortable position.
(b) Upper hip and knee fully extended and held in slight abduction to avoid interference with movement and to eliminate necessity for lifting it in taking test.
(c) Hip of lower leg in 180 degrees extension and adduction; knee fully extended.
Attachments
(a) Strap placed around thigh, lower third between hip and knee joints.
(b) Pulling assembly attached beneath subject.
Precautions
(a) Do not allow lifting of shoulders and hips.
(b) Maintain lateral plane of body perpendicular to plinth.

19. ANKLE INVERSION (Illustrated)
Starting Position
(a) Subject in supine lying position; hip and knee of free leg comfortably flexed with foot resting on plinth; arms folded across chest.
(b) Hip on side being tested extended and adducted to 180 degrees; knee fully extended; ankle at 90 degrees dorsal flexion and mid-position of inversion and eversion.
Attachments
(a) Strap placed around foot directly below ball of foot.
(b) Pulling assembly attached to wall at side away from body.
Precautions
(a) Prevent movement of knee and hip by bracing.
(b) Prevent hip inward rotation by blocking heel with fist.

20. ANKLE EVERSION
The position for this test is the same as for ankle inversion. The pulling assembly, however, is attached to wall at opposite side.

FINGER FLEXION

FOREFINGER EXTENSION

THUMB FLEXION

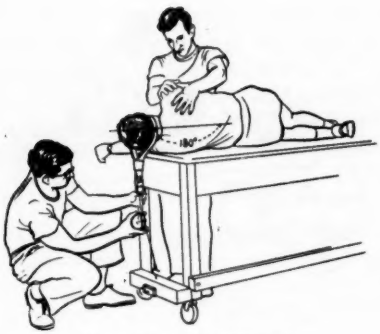
THUMB EXTENSION

WRIST ABDUCTION

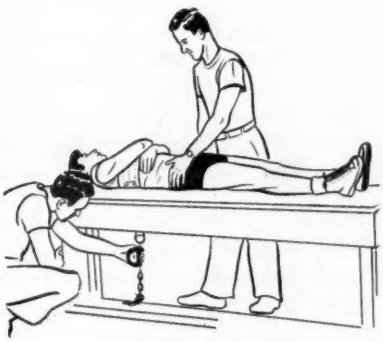
SHOULDER HORIZONTAL FLEXION

NECK FLEXION

NECK EXTENSION



NECK LATERAL FLEXION

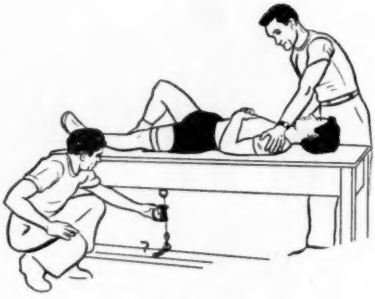


TRUNK FLEXION

TRUNK EXTENSION

TRUNK LATERAL FLEXION

TRUNK ROTATION



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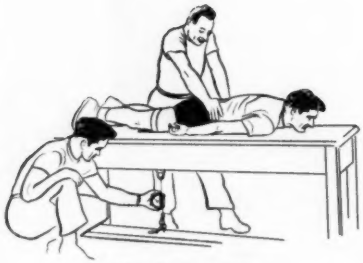

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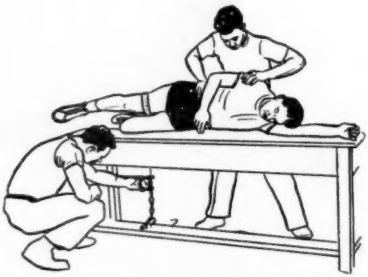
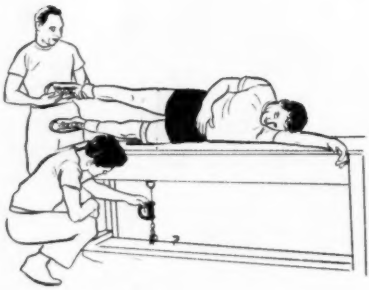
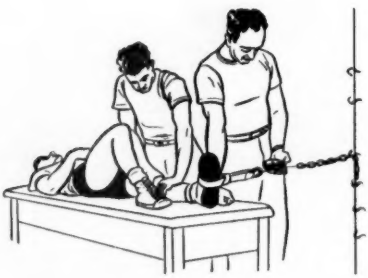


HIP ABDUCTION



HIP ADDUCTION



ANKLE INVERSION

Physical Fitness Improvement of a Middle-Aged Man, with Brief Reviews of Related Studies

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THE 59-YEAR-OLD subject came to the laboratory after hearing other men describe how much they were helped by the physical fitness program operated by the Health and Physical Education Departments of the School of Physical Education. He told a story of being under heavy pressure in his work as professor and head of his department. He complained of having weak and painful feet, sluggish circulation, insomnia and of being overweight. In the past five years he had not taken systematic exercise, but he reported some irregular gardening, golfing, fishing, and canoeing in the summer and some walking. He reported rising blood pressure and increased weight and said he felt poorly some of the time. He desired to try a systematic program as recommended by the laboratory staff in the hope of preventing a breakdown, as several of his sedentary friends had been afflicted during the year.

Training Procedure

A plan was worked out providing for a medical examination and a comprehensive appraisal of his physique, organic efficiency and motor performance check-up. The first complete appraisal was made in December 1949, requiring four separate appointments of approximately one hour each. When all data were in, a program was outlined which consisted essentially of the following features:

1. Walking 2 miles per day, to and from work, five days per week.
2. Home calisthenics before breakfast and before going to bed, 10–15 mins.[2]
3. A daily bath, cool six days and one day per week a short hot bath. Vigorous towel rubs after each bath.
4. Golf or a long hike once per week.
5. Ultraviolet baths in a Burdick shower three times per week.
6. Reduction of fried and starchy foods in the diet and relatively more fruits, vegetables and protein food.

Every month the subject repeated almost all of the tests and the meaning and purpose of each test was explained to him. A few interesting articles and books about physical fitness were called to his attention. In the monthly con-

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[1] As Director of the Physical Fitness Research Laboratory at the University of Illinois, the author sponsored all of the studies reported in this article. The basic data for all of the individuals reported herein are on file in the research office of the laboratory.

[2] These were based upon pp. 45–48, "Introductory Flexibility Exercises," and pp. 61–64, "Posture and Physical Development Exercises," in the *Physical Fitness Workbook* (3rd ed., 1947), C. V. Mosby Co., St. Louis, by T. K. Cureton.

ferences, many of his questions were answered and various explanations and interpretations were given about the exercise dosage, diet, and general hygiene. This was continued for six months in a conscientious manner. No medication was prescribed or used by the subject during this time and his full professional load was sustained throughout the period.

Results Obtained

The test data show that the subject made some important improvements. These can be compared most easily by matching the standard scores which represent percentages of a 100-point distribution in a general population of men 26–60 years of age. These scales were made at the Illinois laboratory after collecting data on men of all types, including laborers, graduate students, farm advisers, ministers, and professors. Data were also obtained from some 50 YMCA's in various American cities.

In *physique* the most important changes were:

	Standard Scores
Reduction of over-all fat	28%
Reduction of abdominal fat	46%
Reduction of waist fat	28%
Reduction of front thigh fat	30%
Loss of weight	2%
Gain in leg strength	10%
Gain in back strength	7%
Gain in strength/weight	7%
Gain in calf girth	18%
Reduction of abdominal girth	2%
Gain in deflated chest girth	7%
Gain in expanded chest girth	4%
Gain in ratio of expanded chest girth to abdominal girth	21%

In *cardiovascular condition* even more important gains were made (Standard Scores):

	Heartometer	*Sphygmomanometer*
Reduced sitting systolic blood pressure	16%	
Reduced systolic blood pressure:		
Lying		20%
Standing		26%
Reduced diastolic blood pressure:		
Lying		41%
Standing		29%
Increased pulse pressure:		
Sitting	0%	
Lying		35%
Standing		18%
Gain in area of heartograph/surface area	39%	
Gain in amplitude of heartograph	43%	
Gain in diastolic amplitude of heartograph	22%	
Gain in diastolic surge of heartograph	50%	
Reduced the angle of obliquity of heartograph	80%	
Gain in 30 step/min. simplified pulse ratio		10%
Gain in sitting pulse rate		14%
Lying pulse rate		30%
Standing pulse rate		20%

Gain in Schneider Index	25%
Gain in rate of pulse recovery after mild exercise	55%
Gain in peak pulse rate after exercise	25%
Gain in the Barach Index	53%
Gain in the Cureton CV Index	31%
Gain in the Tigerstedt Index	22%
Gain in the Stone Index	24%
Gain in the Gale Index	32%
Gain in the Erlanger-Hooker Index	5%

Implications

The results obtained show very large and important gains in physique and cardiovascular condition. The results were obtained by a conscientious individual who worked almost wholly by himself, not in a class. No group game was used—only individual exercise under constant guidance. The testing program was extremely motivating, but the very personal individual talks also helped greatly to keep up the agreed-upon program.

The results show that an older man can make wonderful progress in reconditioning himself by the outlined procedure. Beyond a doubt, the physical fitness procedure should be much more widely applied in every community. It is quite possible that this subject has increased his "distance from death" but it is also known that such gains in physical fitness will quickly deteriorate with reversion to sedentary living and overeating.

A very important aspect is the real meaning of the changes in the test scores. Considerable interpretation, as well as the description of the tests used in this experiment, has already been published.[3] The significance of some of the changes might be readily accepted as being meaningful to improved health, but further research is needed to develop more sharply the interpretations which are justified from the standpoint of health. It might be utilitarian to develop strength; however, we have measured several men, such as John Marshall, the world's record holder in swimming 220 and 440 yd. and 1500 m., who has a marvelous cardiovascular system for that kind of work with fairly poor shoulder strength. It is not fully established that such a high level of cardiovascular condition is the optimum for health or longevity.

Most physicians and physical educators would agree that if the blood pressures and pulse rates were lowered as much as they have been in this subject that the health has been improved. The Barach Index changed from 221.4 to 128.4. This changed the subject from the very bottom of the table to a position somewhat above average in the young men's tables. This would most certainly suggest that with lower vascular tensions the output of the heart is greater and that the body is more adequately supplied with blood and oxygen. This is further supported by the increase in the area of the heartograph and the other associated measures of cardiovascular condition.

It is certainly known that the subject had better endurance and could do more continuous work with less fatigue at the end of the period of training. The

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[3] T. K. Cureton, Jr., *Physical Fitness Appraisal and Guidance*, C. V. Mosby Co., St. Louis, 1947, 566 p.; *Physical Fitness Workbook*, C. V. Mosby Co., St. Louis, 1947, 164 p.; *Physical Fitness of Champion Athletes*, Urbana, Univ. of Illinois Press, 1951, 458 p.

TABLE 1
Record of test data

Subject H. C. M. C.	Tests Nos. 1–2 December, 1949 Raw Scores	Standard Scores 1–2	Standard Scores	Tests Nos. 6–7 June & July, 1950	Standard Score (% Change)
1. Weight (lb.)	198.5	71	69	197	−2
2. Predicted weight (lb.)	195.			192.4	
3. Residual weight (lb.)	+3.5			+4.6	
4. Height	12.02	17	25	12.22	8
5. Table weight	173			179	
6. Somatotype	544	45	45	544	0
7. Normal chest girth (in.)	39.5			40.5	
8. Chest expanded (in.)	41.5	74	78	42.25	4
9. Chest deflated (in.)	38.75	72	79	39.85	7
10. Abdominal girth (in.)	40.25	82	80	39.85	−2
11. Shoulder Width (in.)	Not taken			12.70	
12. Exp. chest—Ab. girth (in.)	1.25	17	38	2.40	21
Skeletal Measures					
13. Chest breadth (in.)	12.8	65	74	13.2	9
14. Ankle girth (in.)	8.3	37	47	8.75	10
15. Chest depth (in.)	9.8	70	70	9.80	0
16. Hip width (in.)	12.9	67	74	13.70	7
17. Height (in.)	70	57	62	71	5
18. Skeletal index	191.4	92	95	197.74	3*
Muscle Girths					
19. Gluteal girth (in.)	42.8	100	100	43.0	0*
20. Calf girth (in.)	14.0	52	70	14.75	18*
21. Biceps girth (in.)	14.3	93	89	14.0	−4*
22. Thigh girth (in.)	22.3	83	79	22.0	−4*
23. Muscular development index	173.4	76	86	180.04	10*
Fat Measures					
24. Cheeks (F. units)	24	30	45	21	15
25. Abdomen (F. units)	40	10	56	24	46
26. Hips (Waist; F. units)	38	25	53	25	28
27. Gluteals (F. units)	40	15	20	38	5
28. Front Thigh (F. units)	34	25	55	23	30
29. Rear Thigh (F. units)	18	62	60	19	−2
30. Fat Index (F. units)	194	13	41	150	28*
Strength					
31. Hand grip, right (lb.)	106	35	37	110	+2
32. Hand grip, left (lb.)	100	37	30	92	−7
33. Back lift (lb.)	350	47	54	380	7
34. Leg lift (lb.)	450	52	62	530	10
35. Total proportional strength	1006	72	73	1110	1
36. Strength/Weight	5.07	34	41	5.67	7
37. Vital capacity					
Cu. in. 37°C.	201	—	—	229	—
Residual	−163	7	18	−125	11

TABLE 1—*Continued*

Cardiovascular Tests					
38. Systolic blood pressure (heartometer, mm. Hg)					
Sitting	150	11	27	129	16
39. Systolic blood pressure (sphygmomanometer, mm. Hg)					
Lying	142	21	41	128	20*
Standing	144	20	46	124	26*
40. Diastolic blood pressure (heartometer, mm. Hg)					
Sitting	95	19	50	74	31*
41. Diastolic blood pressure (sphygmomanometer, mm. Hg)					
Lying	110	0	41	80	41*
Standing	126	0	29	96	29*
42. Pulse pressure (heartometer, mm. Hg)	55	58	58	55	0*
43. Pulse pressure (sphygmomanometer, mm. Hg)					
Lying	32	29	64	48	35*
Standing	18	11	29	28	18*
44. Area of heartograph (sq. cm.)	0.200	25	54	.470	29
45. Area of heartograph/Surface area	0.0971	30	69	.228	39
46. Systolic amplitude (cm.)	0.55	7	56	1.44	43
47. Diastolic amplitude (cm.)	0.38	31	53	.73	22
48. Diastolic surge (cm.)	.02	45	95	.18	50
49. Angle of obliquity (deg.)	29°	0	80	19°	80
50. Sitting pulse rate (heartometer)	72	57	63	68	6
Progressive Pulse Ratios					
51. 12 Steps per min	2.18/157			2.08/146	
52. 18 Steps per min	2.26/163			2.23/156	
53. 24 Steps per min	2.33/168 (BK)			2.41/169	
54. 30 Steps per min	2.70/194 (BK)	35	45	2.56/179	
55. Sitting pulse rate	72	57	71	60	10
56. Schneider Index	13	50	75	18	14
Pulse Rate (beats)					
57. Lying	76	45	70	60	30*
58. Standing	82	54	74	66	20*
59. Pulse rate after 5-step exercise (beats)	100	55	80	80	25*
60. Pulse rate recovery (sec.)	120	30	85	30	55*
61. Barach Index	221.4	4	57	128.4	53*
62. Cureton C. V. Index		34.1	65.2		31.1*
63. Tigerstedt Index	12.50	3	25	27.4	22*
64. Stone Index	14.28	17	41	37.8	24*
65. Erlanger-Hooker Index	1476	22	27	2040	5*
66. Gale metabolic rate (heartometer)	+24%	71	39	−4%	−32*
67. Basal metabolic rate, %	−6%, −7%, −15%		39	−15%, −8%	
Electrocardiogram Leads:	II IV V			II IV V	
68. T (mm.)	1.5 6.7 3.5			1.8 6.7 5.0	
69. R (mm.)	6.0 14.3			5.6 31.3	
70. S (mm.)	−3.8 −7.0 −7.6			−2.9 −4.8	
71. Axis deviation (degrees)	−6.5°			−2.5°	
72. ST displacement (mm.)	−0.5 +0.70 0			0 0	
73. P—QR interval (secs.)	0.23 0.24 0.24			0.24 0.24	

* Young men's tables used because tables on older men were unavailable on these items.

measures seem to indicate that the heart was strengthened and the resistance to the flow of blood through the arterioles and capillary beds was undoubtedly lessened as a result of the training, possibly by opening up many new paths in the capillary beds and by persistent dilatation of the arterioles. It is fully believed that the direction of this shift is desirable and is very beneficial to the cardiovascular system, the nervous system, and general health.

There is a final suggestion that the physical education field should be doing more of this kind of work, working in close association with interested physicians. It is undoubtedly helpful to have the combined reflection and judgment of physicians and physiologists and physical educators on the meaning of the test scores and the changes due to training. This area of interpretation would seem to be absolutely fundamental to understanding what is being accomplished in some of the physical education work which is widely advertised as a valid method for improving physical fitness.

Comment from the Subject

"As a result of systematic exercise I gained physically and tired less quickly either physically or mentally. It may be expressed by saying that the entire system seemed to be toned up.

I have tried to follow the plan systematically which until December 1 included golf or long walk once a week, a cool bath each morning usually to tap water temperature at close, bending and squatting exercise twice a day, and usually walking two miles per day. The cold shower is missed if not taken and it is relished, in fact. I would list the shower as the best conditioner. Bending exercises during the day stir up the circulation and quicken one mentally."

Supporting Studies and Discussion

The changes reported for a single subject do not make a conclusive case for the general population of middle aged men. However, several group studies are now available against which this case can be compared. Similar trends are shown in several of the studies given in the attached bibliography.

The average changes are not as great in the group as in certain individual cases and some of the reasons for this are obvious. With individual cases there are more interviews, the exercises are done six or seven days a week instead of three class periods per week, and the personal attention given to the individual case results in stronger motivation. Gains in the group classes have been significantly greater than control group changes in strength, cardiovascular condition and motor tests, but the gains are relatively greater in classes in which there is sustained endurance exercise.

As would be expected, the gains are greater in aspects of balance, agility, flexibility, strength, and rhythmic endurance rather than in power. The class work is not intensive enough nor long enough continued, in the volleyball classes. Even greater gains result when the individuals are young enough to be intensively trained. Older subjects may be intensively trained but the work must progress much more gradually.

It should also be held in mind that the adult tables used for rating are based

upon realistic data and the standards for the 26–60 year age range are considerably lower than the comparable tables for young men and boys.

Annotated Bibliography of Related Studies (*Men 26–60 Yrs.*)[4]

1. BALEY, JAMES A., *Physical Fitness of Adult Men.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1948. 98 pp. Gives basic data on some 300 men showing marked declines in 18 physical fitness tests in the 26–60 year age span for adult men. Tables are presented showing distribution scales by decades 20–29, 30–39, 40–49, 50–59.

2. BENDER, JAY ALLEN, *The Effects of Exercise on Basal Metabolism.* Urbana: Ph.D. thesis in Physical Education, University of Illinois, 1951. 124 pp. Shows that the basal metabolic rate of adult subjects can be raised by endurance exercise if the rate is lower than normal to begin with. Such change is accompanied by increase in tissue density and also by improved minute and stroke volume.

3. BRODT, MELVIN E., *Changes in Physical Fitness Associated with Weight Lifting.* Urbana: M.S. thesis in Physical Education, 1950. 114 pp. Shows gains of 6 experimental subjects over 10 control subjects in an 18 week program of weight lifting, 3–5 times per week. Strength per pound of body weight increased very significantly, or 11–51 S.S.% gains on the several strength tests compared to 6 S.S.% average gains for the control subjects. Schneider Index, pulse rate, Brouha 5-Min. Step Test and heartometer brachial pulse wave did not increase significantly. Breath holding and vital capacity residuals showed gains of 11 and 27 S.S.%, respectively, significant at the 5% level. Larson's Chinning-Vertical Jump-Dipping Test increased 21.6 S.S.%, significant at the 1% level. Maximum chest girth minus normal abdominal girth increased 6.9 S.S.% over the control group but the gain was not significant. There was no significant change in adipose tissue measurements over the control group. Speed in the Illinois Agility Run increased 18.8 S.S.% over the control group, significant at the 1% level.

4. BRYANT, F. O., *The Effect of Handball on the Physical Fitness of Adult Men.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1950. 109 pp. Shows in 9 subjects significant gains of 13–22 S.S.% compared to a control group of 10 adult subjects; gains of 7–8 S.S.% in the heartometer brachial pulse wave measurements, indicating development of stronger circulation. The Schneider test gain was 9 S.S.% over the controls, significant at the 1% level. Pulse rate, respiratory tests and dynamometer strength did not change significantly over the control group. Speed in the Illinois Agility Run did not change significantly. Expanded chest girth minus abdominal girth improved 5 S.S.% over the control group.

5. HARRISON, AIX B., *Effects of a Swimming Conditioning Program on the Physical Fitness of Adult Men.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1950. 87 pp. Results show gains of 14 S.S.% in normal breath holding time, 10.5 S.S.% in vertical jump reaction time and 13 S.S.% in rhythmic endurance exercises (from 28.5 S.S. average to 41.5 S.S. average compared to young men's standards).[5] Gains of 3–6 S.S.% were obtained for the experimental group in the Schneider Index, the area under the heartometer brachial pulse wave, breath holding on the flarimeter and in the Larson Chinning-Vertical Jump-Dipping Test. No gains were shown in the electrocardiogram T_v wave or in the vital capacity residuals. Total proportional strength dropped 3.5 S.S.%, which indicates that moderate endurance swimming is not an adequate program to build strength but improves mainly the circulatory-respiratory responses, the vertical jump and total body reaction time. No controls were used and the program of training was only 6 weeks with no outdoor exercise.

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[4] All of the subjects used in these experiments were 26–60 years of age, i.e., beyond the undergraduate college age, except in the two individual case studies on Kristufek and Nakamura.

[5] A few items had to be scored on young men's scales due to no scales for older men being available. The *gains* are just as legitimate on the younger tables.

6. HERKIMER, LAWRENCE R., *The Effects of Physical Exercise on Adult Men.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1949. 65 pp. A training program over seven months composed of calisthenics, volleyball, and individually prescribed exercise according to need produced marked cardiovascular gains in 12 experimental subjects ranging 12–18 S.S.% in the heartometer brachial pulse wave measurements but induced insignificant changes in pulse rate, breath holding, and vital capacity residuals. Dynamometrical strength gained 6 and 9 S.S.% in the back and leg lifts and 8 S.S.% in strength per pound of body weight but hand strengths lost an average of 8.5 S.S.%. Dipping strength-endurance gained 10 S.S.%, speed agility 5 S.S.% and maximum chest girth minus abdominal girth gained 9 S.S.% while the total fat reduced from 153 mm. to 138 mm. (sum of 6 measures), equivalent to a fitness gain of 8 S.S.% and a reduction in the weight residuals of 6 S.S.%.

7. HOPKINS, RICHARD E., *The Effects of Volleyball and Calisthenics on the Physical Fitness of Adult Men.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1951. 85 pp. Shows significant gains in a six-months' program offered three times per week for 16 middle-aged men, 26–54 years of age, for the heartometer brachial pulse wave area/s.a. of 30 S.S.%, area 20 S.S.%, obliquity angle 15 S.S.% and systolic amplitude 18 S.S.%. Pulse rate significantly reduced 8 S.S.%. The Schneider Index and vital capacity residuals gained 10 S.S.%. Strength per pound of body weight gained 8 S.S.% and total proportional strength 9 S.S.%. Insignificant changes were observed in breath holding, chinning, grip strengths, vertical jump, total fat, and chest-abdominal girth. Six control subjects changed less than 3 S.S.% in the area of the heartograph/s.a., the systolic pulse wave amplitude, the diastolic pulse wave amplitude and the diastolic surge of the heartograph, the pulse rate, the breath holding time, the vital capacity residuals, the grip strengths, chinning and dipping on parallel bars, the vertical jump, total fat and weight residuals. The rest to work ratio from the heartograms of the controls reduced 15 S.S.% as did the Schneider Test, presumably associated with sedentary living. These controls gained from 9–11 S.S.% in the dynamometer strength test and gained 6 S.S.% in the maximum chest girth minus abdominal girth.

8. KRISTUFEK, CHARLES J., *Effect of Endurance Training on an Adult Subject.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1951. 87 pp. Shows the effect of running three miles per day, 141 miles in 49 days on a 22-year-old subject. Total fat reduced from 130 to 108 mm. while the maximum chest minus abdominal girth index increased 32 S.S.%. Vital capacity increased 20.75 S.S.%. Heart size decreased 2.80% in transverse diameter while stroke volume increased from 68 to 74.4 cc. per beat and oxygen intake increased in an all-out run from 2.12 L./min. to 2.72 L./min. Lying pulse rate decreased from 60 to 48 beats per min. The average heartograph measurement increased 31 S.S.%. The ECG T_v lead increased from 11.2 to 12.0 mm. Breath-holding ability increased 43 S.S.%. Back strength increased 45 S.S.% and leg strength 15.9 S.S.% while grip strength decreased 10.2 S.S.% for the right hand and 2.8 S.S.% for the left. Flexibility was not significantly affected nor were agility, balance or the vertical or broad jump. The Cureton 4-Item Endurance Test increased 5.75 S.S.%, Larson's C-VJ-D Test increased 6.8 S.S.%, while side leg-raisings (average right and left) increased 26.5 S.S.% (61 to 80). The mile-run time improved 5.53% (5:57.8 to 5:38) and the all-out treadmill run at 7 miles per hour, 8.6% slope, improved 31.3% (4:00 to 5:15). Total proportional strength per pound of body weight increased from 6.34 to 7.50, a gain of 20 S.S.%. Compared against 6 control subjects on all but heart size and stroke volume, which were omitted, the net gains averaged 18 to 55 S.S.% in the heartograph brachial pulse wave, 27 S.S.% in the Schneider Test, 20 S.S.% in breath-holding time, 10 S.S.% in vital capacity residuals, 16 S.S.% in back lift, 17 S.S.% in total fat, 18 S.S.% in weight residuals, and 10 S.S.% in the chest minus abdominal girth index.

9. NAKAMURA, PAUL, *Contribution of Swimming to the Physical Fitness of an Adult Male.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1951. 65 pp. The 21-year-old subject during a 10 week training program five days per week, averaged 3/4 mile per day, composed of repeated 100-yard or 200-yard sprints at 5-minute intervals. On one day per week a continuous mile was swum. Fifty different tests of physical fitness were given, all having reliability coefficients of 0.75 or better. The heartograph area gained 61.6 S.S.%, the systolic amplitude 66.6 S.S.% and the obliquity angle 46.7 S.S.%, the Brouha 5-Min.

Step Test 57.2 S.S.%, the Tigerstedt Index 20.7 S.S.%, the Stone Index 23.3 S.S.%, the Gale Index 27.8 S.S.% and the Barach Index 13.3 S.S.%. The ECG T_v wave increased from 7.9 to 14.2 mm. and the R_v wave increased 6.6 mm. while the QRS and P-QR intervals did not change but the rest to work ratio increased from 2.183 to 2.524. The net oxygen intake increased from 2.03 to 2.35 L./min., equivalent to a change from 46 to 53 S.S. The net oxygen debt increased from 5.60 to 7.04 L., a change of 9 S.S.% while breath holding after 2 min. of exercise increased 24 S.S.%. Heart size (Ungerleider-Clark Table) increased from −9.55% to −1.07%, a relative gain of 19 S.S.%, with transverse diameter increasing from 12.03 to 12.70 mm. In terms of the heart condition index (Cureton's):

$$\frac{\text{Area of brachial pulse wave}}{\text{Area of frontal X-Ray}} \times 1000,$$

the initial test was $0.37/115.1 \times 1000 = 3.16$; after training the result was $0.64/114.4 \times 1000 = 5.59$, a gain of 77%. This indicates a gain in heart output capacity per unit of heart size; with heart volume by the Keys and Fridell equation in the denominator, the gain was 79%. Standard scores are not yet available for this index. This ratio is a much better index of heart action and reserve during stress than any known size measurements, ratios of heart size to weight or Grollman stroke volume.[6]

Flexibility in five tests increased from 9 to 23 S.S.% but total proportional strength, expiratory force, back lift and leg lift did not change. Grip strength lost 9 S.S.%. The subject improved from 6:41 to 5:52 in the 440-yard swim; the gain on Cureton's 100-yard Drop-Off Endurance Test in the pool was from a 10-sec. drop-off in a 69-sec. hundred to a 4.2-sec. drop-off in a 59.3-sec. hundred (30 S.S. to 66 S.S. or 30 S.S.% gain). There was no change in chinning or dipping, but the vertical jump improved 6 inches, or 50 S.S.%. The total fat reduced from 90 to 75 mm., a gain of 8 S.S.%. Chest girth increased 11 S.S.% and chest expansion 30 S.S.% but there were no changes in skeletal dimensions. Compared to a control group of 6 subjects, the net gains were dominantly cardiovascular, 30 S.S.% in heartograph area, 32 S.S.% in systolic pulse wave amplitude and 39 S.S.% in diastolic pulse wave amplitude, 35 S.S.% in the Schneider Test, 26 S.S.% in breath holding, 7 S.S.% in vital capacity. There were net losses of 7–11 S.S.% in the various strength tests.

10. VINCITORE, MICHAEL A., *Effects of a Physical Conditioning Program on the Progressive Pulse Ratio Test of Adult Men.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1951. 62 pp. Shows that in the 5-point Progressive Pulse Ratio Test 12 of 14 experimental subjects 26–60 years improved 6.2% compared with a control group of 4 subjects 29–49 years, during six months of calisthenics and volleyball. Eleven of the 14 subjects decreased the angle of mean fit 7° or 15%, whereas the control group did not change. The increased tolerance for exercise shown by 3 of the experimental subjects had an initial break of 27° at the 18 step/min. interval, 8 subjects of 39° at the 24 step/min. interval and 3 of 30° at the 30 step/min. interval. Two of the subjects responded somewhat unfavorably and after a time were referred to the medical department. This interrupted their exercise. On the final test only one subject "broke" at the 18 step/min. point, 7 broke at the 24 step/min. point and 6 broke at the 30 step/min. point. There was a shift in point of break and the average angle and the angles of break were less.

The experimental group averaged initially 154 (at 12), 164.4 (at 18), 172.4 (at 24), 191.4 (at 30) and 217.4 (at 36 steps/min.) for the 2-min. pulse counts after stepping up and down on a 17-in. bench for one minute. After the six months of training, the recuperation pulse counts were 160.5, 165.5, 173.8, 188.1, and 216 beats, respectively. The differences in the recuperation pulse counts before training as compared to after training are insignificant. The initial sitting pulse rates before training were 73.8, 73.8, 74.0 and 73.3 beats per minute; whereas, after training the pulse rates were 76.1, 75.4, 76.6, 76.3 and 76.5 beats per min. The before training pulse rates are not significantly different compared to the post-exercise

[6] R. F. Tosky, *Relationship of Heart Size to the Treadmill Run*, M.S. thesis in Physical Education, University of Illinois, 1951. 53 p.; T. K. Cureton, "The Hearts of Athletes," *Illinois Medical Journal*, 99: 143 (1951).

pulse rates. The pulse rates are, therefore, not reliable indicators of the gains in fitness, whereas, the angular point and the point of "break" do indicate quite reliably the gains in fitness.

11. WOLBERS, CHARLES P., *The Effects of Volleyball on the Physical Fitness of Adult Men.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1949. 103 pp. Shows the effect of 26 weeks of training upon nine experimental adults, 28–50 years. Volleyball was played three times per week and for the first two weeks only light conditioning exercises were given. The subjects were beginners in volleyball. The net changes over and above a control group of 10 sedentary adult male subjects of similar age range were 6 S.S.% in pulse rate, 10 S.S.% in the obliquity angle of the heartograph but there were insignificant changes in the area, systolic amplitude and diastolic pulse wave measurements. The net change in the Schneider test was insignificant. Cardiovascular condition practically did not improve. There were gains of 4 S.S.% in breath holding and 6 S.S.% in vital capacity residuals. The gains in cardiovascular condition were therefore slight but the improvements were much more definite in grip strength, 8 S.S.%, back lift 12 S.S.%, leg lift 16 S.S.%, 13 S.S.% in total proportional strength, and 18 S.S.% in strength per pound of body weight. These large apparent gains in strength are not wholly due to volleyball improving the strength as the experimental group averaged a gain of 7.5 S.S.% in strength and the control group lost 5 S.S.%. Speed in the Illinois Agility Run gained 7 S.S.%, the vertical jump improved 6 S.S.% and the Larson C-VJ-D Test improved 9 S.S.%. The changes in total fat, weight residuals, and chest-abdominal girths were insignificant. The improvements were not impressive and the results create a doubt that volleyball at the beginner's level is much good to develop fitness.

12. WOLFSON, MARTIN, *Effects of a Program of Prescribed Exercises on the Physical Fitness of Adult Men.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1950. 81 pp. Shows that 9 experimental subjects, 26–60 years of age, gained in comparison to 6 control subjects an average of 17 S.S.% in the Schneider Index, 10 S.S.% in the systolic amplitude of the brachial pulse wave, 23 S.S.% in the diastolic surge, 6 S.S.% in pulse rate and 20 S.S.% in the rest-to-work ratio of the heartograph. There were gains of 9 S.S.% in the vital capacity residuals, 10 S.S.% in grip strengths and 8 S.S.% in the Larson C-VJ-D Test, including a 11 S.S.% improvement in the vertical jump. The chest minus abdominal girth gain was 24 S.S.% and total fat loss was 8 S.S.%. The net gain in weight residual (tissue density) was 11 S.S.%.

13. YUHASZ, MICHAEL S., *A Metabolic Analysis of Treadmill Jogging by Adult Men.* Urbana: M.S. thesis in Physical Education, University of Illinois, 1950. 43 pp. Seventeen adult subjects, 27–40 years, jogged for 4 mins. at 5 mi. per hour on the motor-driven treadmill set at an 8.6% grade. The quiet sitting RQ's averaged .81 and the exercise RQ's averaged .99. Age correlated .44 with the RQ, indicating a trend toward lower metabolic efficiency with age. The oxygen debt induced ranged from 2.46 to 8.51 L., averaging 4.20 L. There was no rank-order relationship between age and oxygen intake, which averaged 0.250 L./min. in quiet sitting (.244 to .395 L./min.) and during the jogging averaged 2.20 L./min. (2.04 to 3.25 L./min. gross). The total rate of net oxygen cost (Hill's Oxygen Requirement) averaged 2.955 L./min., with a range of 1.800 to 4.980 L./min. The horsepower averaged .193 (.158 to .241); the foot lb. per min. averaged 6382 (5225 to 7950); the foot lb. of work averaged 25,524 (20,900 to 31,800); and the Caloric equivalent of the work averaged 8.29 (6.78 to 10.60). The ratio of the average total energy rate to the sitting metabolic rate was 12.16. The Cal./Hr./Kg. average was .97 (.83 to 1.33) for the sitting state, whereas, the net energy metabolic rate for the exercise averaged 7.73 Cal./Hr./Kg. (5.66 to 10.02).

There was no relationship between the exercise RQ and the mechanical efficiency.

$$\frac{\text{(Weight} \times \text{cumulative height in jogging)}}{\text{Net energy cost}}$$

The rank-order correlations between mechanical efficiency and age (−.27) and body weight (−.36) were insignificant. The net oxygen debt correlated with mechanical efficiency −.75, greater oxygen debt with lower mechanical efficiency and vice versa. Mechanical efficiency correlated −.80 with gross oxygen intake per minute per kg. of body weight. The mechanical

efficiencies averaged 14.70% (11.10 to 20.80%); net rate of oxygen debt averaged .0143 L./min./Kg. (.0073 to .0272); gross oxygen consumption averaged .0290 L./min./Kg. (.0220 to .0366). The mechanical efficiency correlated .84 with the gross total oxygen consumption. The recovery metabolic rate in Cal/Hr./Kg. correlated −.732 with mechanical efficiency and this relationship was slightly better than when Cal./Hr./Sq.m. relationship was used. The best relationship to mechanical efficiency is the total gross oxygen consumption or Cal./Hr./Kg. which correlated −.96 but this is spuriously high because cost of the exercise is in both variables.

Concluding Comment

1. The comparison of the various improvements in terms of standard score percentages is the best way to compare improvements registered in different units. The measurement rod becomes the 100-point normal distribution scale, divided into equal units of variability in that the entire range of individual differences of the group are divided into 100 equal increments. In this sense the percentages are comparable.

2. It is certainly more difficult to improve a subject in the upper 25 S.S. range than one in the lower 25 S.S. range. In this sense the percentage gains are not strictly comparable.

3. The poor gains in the adult subjects compared to the young subjects (Kristufek and Nakamura experiments) are undoubtedly related to the caution with which the work with the older men is administered. No experiments are in hand on the very strenuous training of older subjects except the data reported in 1947 by Cureton.[7] In this one case the gains were very much greater: lying pulse rate 70 S.S. to 94 S.S. (24 S.S.%); standing pulse 65 S.S. to 100 S.S. (35 S.S.%); pulse after exercise 70 S.S. to 95 S.S. (25 S.S.%); composite heartograph score 67 S.S. to 83 S.S. (16 S.S.%); Schneider Index 65 S.S. to 100 S.S. (35 S.S.%); fat 20 S.S. to 59 S.S. (39 S. S.%); all-out treadmill run, 8.6 per cent grade at 7 mi./hr.; 50 S.S. to 100 S.S. (50 S.S.%); 5-Min. Step Test 42 S.S. to 100 S.S. (58 S.S.%); total proportional strength 55 S.S. to 84 S.S. (29 S.S.%); breath holding 65 S.S. to 100 S.S. (35 S.S.%); abdominal girth 44 S.S. to 85 S.S. (41 S.S.%); chest expansion 75 S.S. to 90 S.S. (15 S.S. %); maximum chest girth minus abdominal girth 70 S.S. to 78 S.S. (8 S.S.%). These gains are comparable to those obtained by young men in severe training.

It is probable that most of the adult men could be trained harder without harm. The principal difficulty is their poor "mind-set" for such work, lack of understanding, and lack of specific objectives. Foremost in their minds are rumors from overly-cautious medical men, such as Dr. Peter J. Steinchron, who have filled the syndicated news columns with warnings that hard physical exercise is probably harmful. It is unfortunate that this physician has not had the personal experience of "training" middle-aged men with exercise and recreation programs.

4. The relatively small improvements in Wolber's volleyball group indicates that there is less continuous endurance work in volleyball. When conditioning exercises are added, the gains are greater. As for handball, the courts

[7] T. K. Cureton, Experiments in Measuring Physical Fitness Gained by Physical Training, pp. 500–511, *Physical Fitness Appraisal and Guidance*, St. Louis: C. V. Mosby Co., 1947.

at Illinois are fairly small and the practice was mostly doubles play. In the novice classes the pace is relatively slow compared to expert play. The "standing around" between plays, time out to discuss technique, and the tendency to socialize—all impede the development of fitness.

5. There is no evidence that swimming in cool water slows the reaction time. The type of work in Harrison's group was at best intermediate level work with only a few lengths ever done at one time. In another study (Forr, 1949) the measured reaction times in the same test improved greatly in a beginning swimming class. This indicates that the work is tonic in effect.

6. Heart size is not increased in low intensity work as given to these adults or to young men. There is confirming evidence in the publication *Physical Fitness of Champion Athletes* (1951) of this, but high speed-endurance work or high altitude exposure again and again may produce unusual hypertrophy. This is borne out in Kristufek's heart not enlarging, whereas, Nakamura's did enlarge. When the heart enlarged, the T_v wave and the area greatly enlarged.

The significant gains indicative of improved fitness were not in the anatomical dimensions but in the improved stroke volume and efficiency by the ratio of output to size. More work on the older subjects is needed. In several of the studies it is reiterated that the quiet pulse rates and the recuperation pulse rates after mild exercise do not reflect the several types of fitness gains made. This is especially convincing in Vincitore's study of the progressive pulse ratio.

The Relationship of Grip Strength to Stature, Somatotype Components, and Anthropometric Measurements of the Hand

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THE HAND GRIP as a test for determining strength was used by Sargent (1) in 1880 at Harvard. Since that time it has become an integral part of strength test batteries, of which McCloy's (2) and Rodger's (3) are widely known. In addition to strength batteries, grip strength has been used as a measure of "physical fitness", physiological growth, and hand dominance.

On the basis that grip strength is reasonably representative of total body strength, Bookwalter and others (4) have set up "norms" for grip strength by age, weight, and classification index categories. Thus, the grip strength of an individual may be compared with others of the same age, weight, and classification index. Earlier studies by Smedly (5) and by Meredith (6) have listed mean grip strength scores by age classifications. Thus, on an age basis, grip strength scores may be compared with these findings.

Further studies have found relationships between grip strength and various other factors. Gates (7) found, in a sampling of junior primary and fourth grade pupils, that grip strength correlated .45 with height, .40 with weight, .36 with chest girth, .46 with lung capacity, and .31 with physical vigor. Baldwin (8) found that right grip strength and chronological age had a correlation of .762 for boys between the ages of seven and fifteen years, while Johnson (9) found a correlation of .765 for boys between the ages of 3 and 13 years for the same two factors.

Since we found no studies of the relationship of grip strength to hand length, hand width, palm length, and finger length, it was decided to investigate the possible influence of these variables upon hand grip strength. Somatotype ratings were also included in the test battery in an effort to gain additional information relative to the influence of endomorphy, mesomorphy, and ectomorphy upon grip strength. No effort was made to place the subjects in certain body build classifications, and the three components were treated as independent variables.

Procedure

Four hundred students ranging in age from 14 to 29 years (less than 6 per cent over 20 years of age) were measured. Measurements were taken with the student in gym shorts. After obtaining his age, height, and weight the student was then instructed to sit in a desk armchair. The stylion of the right arm was

TABLE 1

Zero order correlations

(Variable no.)	Hand Grip (1)	Hand Width (2)	Weight (3)	Height (4)	Age (5)	Hand Length (6)	Finger Length (7)	Meso-morphy (8)	Palm Length (9)	Endo-morphy (10)	Ecto-morphy (11)
Hand Grip	—										
Hand Width	.6282	—									
Weight	.6582	.6195	—								
Height	.5965	.5691	.6245	—							
Age	.4694	.4465	.4731	.4285	—						
Hand Length	.5034	.5622	.4856	.7147	.2565	--					
Finger Length	.4947	.6155	.4646	.6610	.3315	.7906	—				
Mesomorphy	.4428	.3570	.3061	−.0019	.2308	.0207	.0546	—			
Palm Length	.3539	.3408	.3473	.5332	.1109	.8577	.3666	−.0144	—		
Endomorphy	−.0238	−.0382	.4927	−.0746	−.0094	−.0763	−.1112	−.1755	−.0274	—	
Ectomorphy	−.0581	−.0235	−.2601	.3779	.0837	.2250	.2202	−.4726	.1597	−.4866	—
Mean	113.15 lbs.	8.79 cm.	152.14 lbs.	68.87 in.	17.91 yrs.	20.10 cm.	8.38 cm.	3.73	11.72 cm.	1.72	2.45
S.D	21.05	.53	26.42	3.08	2.32	1.03	.56	1.05	.68	1.13	1.35

marked with a skin pencil and the subject then placed his hand with fingers extended on a piece of paper so that the stylion was at the edge of the paper. The paper was marked at the end of the dactylion (middle finger), at the base of the fingers between the index and middle finger, and at the most lateral projections of the distal heads of the second and fifth metacarpals. From these marks the hand measurements were obtained by the use of a flat caliper.[1]

This method facilitated testing and also reduced the amount of time needed to test each subject. After the hand measurements were obtained, the grip strength of the right hand was tested on a Narragansett dynamometer. Each subject was given three trials and the best result used. The testing technique described by McCloy (2) was followed. Following this test, each subject was somatotyped using the procedure described by Sheldon, Stevens, and Tucker (10).

Analysis of Data

ZERO ORDER CORRELATIONS

We found that all of the variables, with the exception of endomorphy and ectomorphy, correlated positively with hand grip strength. These correlations ranged from .3539 for palm length to .6582 for weight. It was noted that the measurement for hand width gave the second highest zero order correlation, while height ranked third in its correlation with grip strength.

The intercorrelations for the hand measurements indicated, for the most part, substantial relationships. Palm length did not, however, correlate well with hand length and finger length.

The mesomorphic variable was positively correlated with grip strength. This result substantiated the findings of other studies (11, 12) concerning the relationship of strength to body type. For the most part, the remaining correlations had been determined in earlier studies and the results of the present study were similar to those previously reported.

PARTIAL CORRELATIONS

Thirty-six partial correlations were computed. The results indicated that greater reductions in the correlation of grip strength with any of the other variables were realized when either weight, height or one of the hand measurements (hand width appeared to be the more influential of the hand measurements) was held constant (Table 2). It was found that the differences in the zero order correlations and the partial correlations were large enough to conclude that the relationship of hand grip to any one of the variables included in the study was not too substantial. The correlation of weight with hand grip was reduced to a lesser degree through partialing than was the correlation between hand grip and any of the other variables.

When endomorphy was partialed out, there was little reduction in the corre-

[1] All measurements of the hand were recorded in centimeters and height was recorded in inches. The hand measurements were taken by Everett and reliability coefficients of above .90 were found for each measurement used in the study.

TABLE 2
*Partial correlations**

$r_{12.3} = .3725$	$r_{13.2} = .4398$	$r_{14.2} = .3736$
$r_{12.4} = .4375$	$r_{13.4} = .4087$	$r_{14.3} = .3155$
$r_{12.5} = .5298$	$r_{13.5} = .5606$	
$r_{12.6} = .4831$	$r_{13.6} = .5477$	
$r_{12.7} = .4726$	$r_{13.7} = .5567$	
$r_{12.8} = .5613$	$r_{13.8} = .6123$	
$r_{12.9} = .5773$	$r_{13.9} = .6103$	
$r_{12.10} = .6279$	$r_{13.10} = .7695$	
$r_{15.2} = .2713$	$r_{16.2} = .2334$	$r_{18.2} = .3006$
$r_{15.3} = .2382$	$r_{16.3} = .2793$	$r_{18.3} = .3367$
$r_{15.4} = .2949$	$r_{16.4} = .1374$	$r_{18.4} = .5531$
$r_{15.8} = .4209$	$r_{16.5} = .4488$	$r_{18.5} = .3893$
$r_{15.10} = .4694$		$r_{18.10} = .4456$

* The variables are numbered as in Table 1.

lations, and in one case, a gain of from .6582 to .7695 occurred. This fact was attributed to the negative relationship of endomorphy to grip strength. The ratings for endomorphy might very well be associated with "dead weight", that is, that part of body weight which is detrimental to the performance of strength tests.

MULTIPLE CORRELATIONS

Sixteen multiple correlations of various combinations of variables with the hand grip variable were computed. The highest multiple correlation was obtained through the use of six variables and the criterion variable. These six variables were selected on the basis of the zero order and partial correlations previously computed. Two multiple correlations of the fifth order were determined and it was found that the highest correlation was that which included weight, height, finger length, mesomorphy, and age.

Five multiple correlations of the fourth order ranged from .7726 to .6548. The highest of these included weight, height, finger length and mesomorphy. This correlation was only .0111 less than that obtained when six variables were correlated with hand grip. The four third order multiples were lower than the highest four of the fourth order correlations, with the combination of hand width, height, and weight the best (.7335). The highest second order correlation of .7156 was found to include hand width and weight.

TABLE 3
Multiple correlations

$R_{1.234678} = .7837$		$R_{1.234} = .7335$
		$R_{1.347} = .7004$
$R_{1.34785} = .7794$		$R_{1.345} = .7029$
$R_{1.23467} = .7338$		$R_{1.267} = .6542$
$R_{1.3748} = .7726$		
$R_{1.2348} = .7609$		$R_{1.23} = .7156$
$R_{1.3458} = .7523$		$R_{1.34} = .6997$
$R_{1.2345} = .7430$		$R_{1.26} = .6539$
$R_{1.2346} = .7330$		
$R_{1.2679} = .6548$		

Summary

In summarizing, it was evident that the variables of weight, height, the mesomorphic component, and an anthropometric measurement of the hand all contributed to the higher multiple correlations with hand grip strength. When any one of these variables was deleted a significantly lower correlation resulted, thus indicating that each of these variables was of sufficient importance to merit consideration in future studies of hand grip strength.

The use of only one anthropometric measurement of the hand proved to be adequate since the use of more than one added little or nothing to the multiple correlations. In order that the influence of hand size be considered in future studies, either an adjustable grip dynamometer or scoring tables that include hand measurement should be utilized.

For the subjects who were tested, age had little influence upon grip strength. This fact was emphasized when other variables were held constant and age was correlated with grip strength. In previous studies (8, 9) when samples were taken from younger age groups, higher correlations for grip strength with age were found. We believed that these differences would have been minimized if the same variables had been held constant in each of the studies when grip strength and age were correlated.

Conclusions

1. Weight correlated the highest with hand grip strength, caused the greatest decrease in most of the partial correlations when it was held constant, and was included in the highest multiple correlations of each order.

2. Hand width had the second highest correlation with hand grip strength, while hand length and finger length ranked fourth and fifth respectively. Hand width caused substantial decreases in the partial correlations, while finger length was included in the highest fourth order multiple correlation.

3. Height ranked third in the zero order correlations with hand grip strength, caused the greatest decrease in two of the partial correlations, and was included in the highest multiple correlation of each order except the second.

4. Mesomorphy ranked seventh in the zero order correlations with hand grip strength, but did not cause much of a decrease in the partial correlations, but was a part of the highest fourth, fifth, and sixth order multiple correlations. The correlations for the other two components with grip strength were not significant.

5. Age ranked sixth in its correlation with hand grip strength, caused slight decreases in the partial correlations when it was held constant, but added very little to the multiple correlations when it was included.

6. Throughout the correlational analysis it was evident that weight, an anthropometric measurement of the hand, height, and mesomorphy were the most influential variables in the prediction of hand grip strength.

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Health Education as a Requirement for Certification of Secondary School Teachers

In Academic Fields, Physical Education, Health and Physical Education, and School Health Education

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TEACHER CERTIFICATION is the legal authority to teach which is granted a person meeting basic requirements set by state certifying agencies. The candidate can meet these requirements either by submitting necessary college credentials, or by submitting a record of teaching experience, or by the passing of an examination given by the certifying agency (3). The certificate or license is the proof of the certification. It should be understood that these requirements of certification are the minimum in teacher preparation.

If certification represents the minimum in preparation, then, what health education requirements are necessary for certification of secondary school teachers in the academic fields, in physical education, health and physical education, and school health education?

This question was answered through an analysis of certification requirements for secondary school teachers in the 48 states and the District of Columbia between October 1949 and October 1951. Cities with special certification requirements were not included.

Purposes and Methods

This study had three purposes: (1) to determine the extent of health education as a requirement in general education, professional education, and in the special fields for certification of secondary school teachers throughout the United States; (2) to find and to analyze the differences in the health education requirements; (3) to find and to analyze the health education differences as certification requirements among the states. In both 1949 and 1951, certification requirements issued by state certifying agencies were analyzed and a compilation of general education, professional education, and special certification requirements resulted.

Review of Literature

The implications of health education as a requirement for certification of secondary school teachers were first indicated in those states that either recognized health education as a teaching field with special certification requirements or combined the requirements of health education with those of physical education. In 1924, the United States Office of Education issued its first study of

certification requirements for physical education and health education teachers in secondary schools. California, Connecticut, Florida, and Michigan offered certification in health education while Alabama, Iowa, Louisiana, Ohio, Pennsylvania, Tennessee, Texas, and Virginia combined health education with physical education (13).

The 1924 publication of the Joint Committee on Health Problems in Education of the National Education Association and the American Medical Association stressed the importance of health education in the preparation of secondary school teachers (5). Stetson and Cozens not only reported the growth of health education as a teaching subject but also indicated the lack of health education leadership in state departments and in individual schools (12). Between 1927 and 1933, publications by Neilson (9) and Oberteuffer (10) spurred the recognition of health education as a requirement for certification. The 1942 study by Morehouse and Schaaf revealed that a maximum of 11 semester hours was the total health education requirement for a physical education teacher who wished to obtain a certificate in all of the 48 states (7). The Twentieth Yearbook of the American Association of School Administrators had considerable influence as to the recognition and importance of the school health educator in the secondary schools (1).

In 1943, the Committee on Educational Qualifications of Health Educators, appointed by the United States Commissioner of Education, proposed specific preparation for school health educators and made recommendations to state departments for the development of certification requirements for these educators (2). During the same year, the National Conference for Cooperation in Health Education emphasized the need for extensive programs of health education in the training of teachers, since the teacher held an important role in the school health program (8). Further emphasis on the need for health education in the preparation of all teachers was stressed in the article by Rugen. This article also showed the possibilities of in-service education of secondary school teachers by the school health educator (11). In 1947, the Health Education Division of the American Association of Health, Physical Education, and Recreation set among others these platforms for health education: trained school health educators and health *and* education to be included in the preparation of these educators (4). These two platforms were advocated in 1948 by the Joint Committee on Health Problems in Education of the National Education Association and the American Medical Association (6). Since 1924, this Joint Committee has continued its plea that all secondary school teachers receive training in health education and that a school health educator be a member of the instructional staff of the secondary school.

Findings

The findings of this study are divided into four groups; (1) health education requirements for secondary school teachers in academic fields; (2) health education requirements as a part of the special requirements for persons certified to teach secondary school physical education; (3) health education requirements

as a part of the special requirements for persons certified to teach secondary school health and physical education; (4) health education requirements for persons certified to teach secondary school health education.

Since state certifying agencies list health education as a requirement fulfilling either general education, professional education, or the over-all pattern of certification for secondary school teachers, states will be listed individually.

Arizona

1949— No mention of health education.

1951— Courses in health education are required of the 24 semester hours in education and psychology, appropriate to secondary school teaching (School and Community Health).

Arkansas

1949, 1951— Six semester hours in health, safety, and physical education are listed in the general requirements for high school teachers.

California

1949— No mention of health education in the General Secondary Credential.

1951— Health education is to be included in the 40 semester hours of general education for the General Secondary Credential, effective September 1, 1951.

Florida

1949, 1951— Health is listed as one of the areas to be met in the eight semester hours requirement of human adjustment, a subdivision of general preparation.

Illinois

1949— Health education was combined with physical education for a two to four semester hour requirement of general education in the Limited State Special Certificate and had a two to three semester hour requirement of general education in the Limited State High School Certificate.

1951— Health education is combined with physical education as a requirement of general education in both the Limited State Special and the Limited State High School Certificates. Three semester hours of this combination are the minimum for each certificate.

Kentucky

1949, 1951— Six semester hours of health, safety, and physical education are a part of the general requirements.

Louisiana

1949, 1951— Four semester hours of health and physical education are a part of the general education requirements.

Mississippi

1949, 1951— Three semester hours in personal hygiene and/or school and community health are a part of the requirements for general education.

Missouri

1949— A course in health or hygiene had to be satisfied to meet general requirements.

1951— Two semester hours of health or hygiene are listed under general requirements.

Nebraska

1949— Two semester hours of physiology and hygiene were required for the initial certificate.

1951— Two semester hours of health education are required for the initial certificate.

New Jersey

1949, 1951— At least one course in health education is required as a part of professional education.

South Carolina
1949, 1951— Three semester hours of health education are required as a part of general education.

Utah
1949, 1951— Two semester hours of health education are required as a part of professional education.

Virginia
1949— No mention of health education.
1951— Two semester hours must be in health education of the total six semester hours of health, safety, and physical education as a part of general education.

Washington
1949— No mention of health education.
1951— Health education must be included with the 40 semester hours of general education for the General Certificate.

West Virginia
1949— No mention of health education.
1951— Two semester hours in Health Problems for School Child is listed under the required courses for the Public School Certificate.

Table 1 shows health education as a part of the special requirements for persons certified to teach secondary school physical education.

Table 2 presents health education as a part of the special requirements for persons certified to teach secondary school health and physical education.

Table 3 lists health education requirements for persons certified to teach secondary school health education.

Summary

HEALTH EDUCATION AS A REQUIREMENT FOR SECONDARY SCHOOL TEACHERS IN ACADEMIC FIELDS

1. In 1949, 11 states listed health education as a part of either the general education or professional education requirements. In 1951, five states were added to this list.

2. The range of semester hours in health education as a part of either the general education or professional education is from two to three. The average requirement is 2.4 semester hours in 1951.

3. Health education is generally replacing the terms "hygiene" or "health."

4. In 1951, health education has been accepted as a part of the general education requirements in 11 of the 16 states.

5. In 1951, only five of the 16 states list health education with physical education.

HEALTH EDUCATION AS A PART OF THE SPECIAL REQUIREMENTS FOR PERSONS CERTIFIED TO TEACH SECONDARY SCHOOL PHYSICAL EDUCATION

1. In 1949, 13 states listed health education as a part of the special requirements. In 1951, one state was added to this list.

2. Of the 14 states, four states gave total semester hour requirements in health education. The range of semester hours in health education of these four states is four to eleven. The average requirement is 5.3 semester hours in 1951.

TABLE 1

Health education as a part of the special requirements for persons certified to teach Secondary School Physical Education

State	Year	Degree	Total P. Ed. Semester Hours Required	H. Ed. as a Part of P. Ed.	Total H. Ed. Semester Hours	Health Education Courses or Areas Required																				
						Methods of H. Ed.	Hygiene and First Aid	School Health Program	First Aid	Hygiene	Personal Hygiene	Community Hygiene	School Health Ed.	Public Health	Child Hygiene	Immunology	Health and Safety	Safety Ed.	Sanitation	Materials—H. Ed.	Physical Inspection	Mental Hygiene	Social Hygiene	Foods and Nutrition	Disease Control	Health Counseling
Arkansas	1949	Bachelor's	25	x													2*									
	1951	Bachelor's	25	x													2									
California	1949	Bachelor's	24	x																						
(Special Secondary Credential)	1951	Bachelor's	24	x																						
Colorado	1949	—	31	x		2/3	4														2					
	1951	Bachelor's	31	x		2/3	4														2					
Iowa	1949	Bachelor's	20	x				4																		
(Special Subject)	1951	Bachelor's	20	x				4																		
Kansas	1949	Bachelor's	40	x					x	x																
(Special Certificate)	1951	Bachelor's	40	x					x	x																
Maryland	1949	Bachelor's	30	x							x	x														
(Special Subjects)	1951	Bachelor's	30	x							x	x														
New Hampshire	1949	Bachelor's	18	x																						
	1951	Bachelor's	18	x																						
New Jersey	1949	Bachelor's	48	x					x		x	x						x								
	1951	Bachelor's	40	x					x		x	x						x								
New York	1949	Bachelor's	36	x					x									x			x					
(Provisional Special Subject)	1951	Bachelor's	36	x					x									x			x					
North Carolina	1951	Bachelor's	30	x	4–7	x					x			x	x	x			x	x						
Ohio	1949	Bachelor's	16	x	4	x							x													
1) Provisional High School Certificate	1951	Bachelor's	24	x	7	x			x		x	x							x	x		x	x	x	x	x
2) Provisional Special Certificate	1949	Bachelor's	40	x	10	x					x		x	x	x	x			x							
	1951	Bachelor's	46	x	11	x			x		x	x							x	x		x	x	x	x	x
Oklahoma	1949	Bachelor's	24	x					2																	
	1951	Bachelor's	24	x					2																	
West Virginia	1949	Bachelor's	24	x	4					x			x								x					
	1951	Bachelor's	24	x	4					x			x								x					
Wisconsin	1949	Bachelor's	30	x	12																					
	1951	Bachelor's	20	x	4	x			x									x		x						

* Numbers indicate semester hours.

TABLE 2

Health education as a part of the special requirements for persons certified to teach Secondary School Health and Physical Education

State	Year	Degree	Total Health and Physical Education Semester Hours	Health Education as a Part of Health and Physical Education	Total Health Education Semester Hours	Health Education Courses or Areas Required																	
						First Aid	Safety Education	Personal Hygiene	Community Hygiene	School Health Program	Hygiene	Nutrition	Mental Hygiene	School and Community Health	Physical Inspection	Methods of H. Ed.	Materials of H. Ed.	Child Hygiene	Sanitation	Immunology	Public Health	H. Ed. Content	H. Exam. and Follow-up	Family Life Ed.
Georgia	1951	Bachelor's	30	x																			
Illinois	1949	Bachelor's	32	x																			
1) Limited State High School	1951	Bachelor's	32	x																			
2) Limited State Special	1949	Bachelor's	36	x																			
	1951	Bachelor's	36	x																			
Indiana	1949	Bachelor's	40	x	15	x	x	x	x	x													
1) Secondary Provisional	1951	Bachelor's	40	x	15	x	x	x	x	x													
2) Special Secondary Provisional	1949	Bachelor's	60	x	22.5	x	x	x	x	x													
	1951	Bachelor's	60	x	22.5	x	x	x	x	x													
Louisiana	1949	Bachelor's	41	x	6																		
	1951	Bachelor's	41	x	6																		
Mississippi	1949	Bachelor's	30	x	15	x	x				x	x	x	x	x	x	x						3*
(Special Subject)	1951	Bachelor's	30	x	15	x	x				x	x	x	x	x	x	x						3
Missouri	1949	Bachelor's	24	x																			
	1951	Bachelor's	24	x	8																		
North Carolina	1949	Bachelor's	30	x	5–7			x								x	x	x	x	x	x		
Pennsylvania	1949	Bachelor's	30	x	10																		
(Provisional)	1951	Bachelor's	30	x	10																		
Rhode Island	1949	Bachelor's	24	x												x	x						
	1951	Bachelor's	24	x												x	x						
South Carolina	1949	Bachelor's	24	x	3–4	x	x	x	x														
	1951	Bachelor's	24	x	3–4	x	x	x	x														
Tennessee	1949	Bachelor's	14	x	6	x	x					x										x	x
	1951	Bachelor's	14	x	6	x	x					x										x	x
Utah	1949	Bachelor's	40	x	12																		
General Secondary	1951	Bachelor's	40	x	12																		
1) Composite major	1949	Bachelor's	20†	x																			
2) Major and minor	1951	Bachelor's	20†	x																			
Virginia	1949	Bachelor's	12	x																			
	1951	Bachelor's	24	x	8	x	x			x						x	x						

* Numbers indicate semester hours.

† Major.

TABLE 3

Health education requirements for persons certified to teach Secondary School Health Education

State	Year	Degree	Total Semester Hours H. Ed.	Health Education Courses or Areas Required																		
				Mental Hygiene	Health Counseling	Family Life Ed.	Foods	Nutrition	Mat. & Inf. Health	Home Nursing	Personal Hygiene	School Health	Community Health	Safety Education	Occupational Hygiene	Organization, Administration, Supervision, School Health Program	Principles, Methods, and Materials	Prob. Sec. Sch. H.	First Aid	El. Sch. H. Program	Sch. & Com. H. Program	Sec. Sch. H Program
California (General Secondary Credential)	1951	Bachelor's plus 30 graduate hours	36	x		x		x			x	x	x	x	x							
Connecticut	1949	Bachelor's	18													x	x	x				
	1951	Bachelor's	18													x	x	x				
Florida	1949	Bachelor's	30	x	x	x		x	x	x	x	x	x	x		x	x		x	x	x	x
	1951	Bachelor's	30	x	x	x		x	x	x	x	x	x	x		x	x		x	x	x	x
Idaho	1949	Bachelor's	15																			
	1951	Bachelor's	15																			
Illinois	1951	Bachelor's	32																			
1) Limited State High School	1949	Bachelor's	36																			
2) Limited State Special	1951	Bachelor's	36																			
Nebraska (Initial Secondary)	1951	Bachelor's	15																			
New Jersey	1949	Bachelor's	48	x	x	x	x	x			x		x	x		x	x		x			
	1951	Bachelor's	40	x	x	x	x	x			x		x	x		x	x		x			
New York	1949	Bachelor's	36	x	x	x	x	x		x	x	x	x	x		x			x			
(Provisional Special Subject)	1951	Bachelor's	36	x	x	x	x	x		x	x	x	x	x		x			x			

3. The following courses have the greatest frequencies in the health education requirements among the 14 states:

First Aid	6 states
Methods of Health Education	4 states
Personal Hygiene	4 states
Community Hygiene	3 states
Physical Inspection	3 states
Materials of Health Education	3 states
Safety Education	3 states

4. Ohio has increased the total semester hour requirement in health education for 1951.

HEALTH EDUCATION AS A PART OF THE SPECIAL REQUIREMENTS FOR PERSONS CERTIFIED TO TEACH SECONDARY SCHOOL HEALTH AND PHYSICAL EDUCATION

1. In 1949 and 1951, 12 states listed health education as a part of the special requirements.

2. Of the 12 states, ten states gave total semester hour requirements in health education. The range of semester hours in health education of these ten states is three to 22.5. The average requirement is 9.7 semester hours in 1951.

3. The following courses have the greatest frequencies in the health education requirements among the 12 states:

First Aid	5 states
Safety Education	5 states
Methods of Health Education	4 states
Materials of Health Education	4 states

4. Both Missouri and Virginia are requiring that one-third of the total semester hours be in health education. In 1949, neither state had made any specific health education requirement.

HEALTH EDUCATION REQUIREMENTS FOR PERSONS CERTIFIED TO TEACH SECONDARY SCHOOL HEALTH EDUCATION

1. In 1949, six states certified persons to teach secondary school health education. In 1951, two states were added to this list. The General Secondary Credential became effective September 1, 1951 in California.

2. Of the eight states, the range of semester hours in the total health education requirement is 15 to 40. The average requirement is 28 semester hours in 1951.

3. The following courses have the greatest frequencies in the health education requirements among the eight states:

Mental Hygiene	4 states
Family Life Education	4 states
Nutrition	4 states
Personal Hygiene	4 states
Community Hygiene	4 states

Organization, Administration, and Supervision of the School Health Program ..... 4 states
Safety Education ..... 4 states

In addition to the above summary, 13 states, in 1951, certify persons to teach secondary school physical education but make no mention of health education in the special requirements. In the special requirements for physical education, these 13 states have a range of semester hours from 15 to 60. Also, seven states, in 1951, certify persons to teach secondary school health and physical education but make no mention of health education in the special requirements. In the special requirements for health and physical education, these seven states have a range of semester hours from 24 to 48.

Conclusions

It is evident that health education is being required for certification of secondary school teachers in academic fields, in physical education, health and physical education, and school health education; however, the facts presented in this study show the need for:

1. Recognition, by certifying agencies, of school health education as a basic area of the professional core in the requirements for certification of all secondary school teachers. To place school health education in the general core, labeling it as "health," "health education," or "hygiene" does not imply adequate understanding of school health education.

2. Investigation, promoted by the certifying agencies and conducted by school health educators in the public schools and in the teacher-training institutions with the assistance of other school health personnel, of the needs of secondary school teachers in school health education. The needs of the teachers in the academic fields will differ considerably from teachers in physical education and in health and physical education.

3. Defining of health education terminology used by certifying agencies. The confusion existing as to courses and areas required for certification shows the need for an understanding of school health education by certifying agencies.

4. Acceptance of school health education as a broad area in the professional core and as an area that can not be satisfied by a three semester hour requirement. If the secondary school teacher is to understand his responsibilities, his relationships with other school health personnel, and his limitations in school health education, there is need for a broad area of school health education in the professional core.

5. Requiring of a broad area of training in school health education with an equivalent area of training in physical education for certification of secondary school health and physical educators. This would eliminate the unfair distribution of physical education requirements in comparison to the health education requirements.

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A Determination of Concepts of Healthful Living and Their Relative Importance for a General Course in College Health

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SCHOPENHAUER, a German philosopher, once very wisely remarked, "the greatest of follies is to neglect one's health for any other advantage of life." The impact of such a profound statement needs to be more keenly felt in institutions of higher learning. While the value of a college education cannot be underestimated, there hardly seems justification for improper consideration for the health of the student during college days and also for the lack of adequate preparation in education for healthful living as an intelligent member of society.

Any emphasis which the health of college students has received has been made chiefly within the past two decades. In addition, attention to the problem of health services has generally been greater than that given to health instruction. With the present awareness of the need for an adequate instructional program, it is believed essential that the foundation be built upon those health concepts deemed most desirable in contributing to healthful living of students, both during college days and in later membership in adult society.

Nature of the Problem

Statement of the Problem. It is the purpose of this study to determine those fundamental concepts of healthful living, and their relative importance, as being of functional value both for the present and future in serving as a basis of a general course in health instruction for college students.

Importance of the Study. As far back as 1856, President Stearns of Amherst College (Massachusetts) deplored the fact that ill health caused many students to leave school. He believed that this was not necessary if proper preventive measures were taken. Although colleges gradually began to take some recognition of the importance of the health of students, it was not until about slightly more than 20 years ago that any real attempts to do anything about it were initiated.

In one major respect, any emphasis that has been made on college health has been placed upon the wrong thing—cure rather than prevention—as attention

has been given to health service while health instruction has often been neglected or overlooked.

While educators are prone to state that health is one of the cardinal objectives of education, they have often failed to practice what they preach. We see about us evidences of scientific advancement against death and disease, yet we also see educational institutions failing to inculcate the extreme importance of sound health knowledges, attitudes, and practices. It should be the function of every school to help share in the task of properly preparing each person for acceptance of responsibility for wholesome health behavior.

Citing the need for an adequate health instructional program is not difficult to do. In the *Proceedings* of the Second National Conference on College Hygiene we find this statement, "Current classroom instruction in hygiene rates commonly with the poorest teaching in our educational institutions." (**11:** *p. 9*)

Diehl and Shepard in their report for the American Council on Education make the following observation: (**5:** *p. 59*)

> Every college student should learn to correct erroneous thinking and develop rational and intellectual discrimination. In no area is need for this more evident than health teaching, since the most important single health problem of college students revolves around health ignorance. The most fundamental activity of the college health program, therefore, is concerned with the dissemination of sound health information.

Voltmer and Esslinger state that, "health instruction deserves much more consideration in high schools and colleges than is being given it today . . . When everything is considered, it must be recognized that hygiene is one of the most poorly presented subjects in the entire curriculum." (**19:** *p. 152*)

The need for raising the health level of the total population has been vividly illustrated by the medical findings on examinees for World War II. The increasing trend toward a greater incidence of mental illness also strikingly evidences a need for sound health education. The National Health Survey (*3*) has also presented comprehensive data as to the general status of the health of the nation.

The ultimate aim of health education is to raise the health level of the nation as a whole. In this respect we must not be too impatient for results. Irwin wisely points out that, "the value of health education should be considered in view of the length of time necessary to raise the level and standards of the population as a whole. It should not be considered on a yearly basis but on the basis of a generation." (**6:** *p. 257*)

Ruthven, in stressing the need for health education at the college level, makes the following remarks: (**14:** *p. 225*)

> Colleges have been providing some degree of cure by means of health services, but have failed tremendously in providing prevention by neglecting health education. Health education has not gained respect and support because it has not been given proper place in the curriculum. . . . We need to insist that colleges and universities give due attention to the teaching of health principles as a determining factor in the protection and promotion of health.

The value of the establishment of principles as a basis of instruction is supported by various authorities. Caswell and Campbell state, "It has been

common practice in curriculum programs to endeavor to provide for consistency of action through the statement of principles to guide the work. Preparation of such statements is customarily looked upon as one of the first tasks in the development of the curriculum program" (**4:** *p. 83*).

In this study the viewpoints of Billett will be followed in relation to the understanding of the term concept. Billett states, "concepts are teacher's goals. They are recognizable advances in educative growth to be made by the pupils .... They are clues to the experiential sequence by means of which the necessary meanings and insights will be developed." (**2:** *p. 273*)

There can be no doubt that considerable research needs to be done in the area of health instruction at the college level. In the attainment of the objectives of college health instruction as outlined by the Third National Conference on College Health (**18:** *p. 44*), it would appear that the determination of fundamental concepts and their relative importance for healthful living would represent a valuable contribution.

Review of the Literature

Studies in Science Education. Pioneer work in the identification of principles which can serve as a basis of the instructional program has been carried out in the field of science. The Thirty-First Yearbook of the National Society for the Study of Education (10) advocated that all science instruction be organized around certain broad generalizations or principles. Various studies have evolved from these recommendations. The most noteworthy were those of Wise (21) and Martin (8).

Studies in Health Education. Staton (15) was the first to undertake research patterned after the work done with principles in the science area. The purpose of his study was to determine the fundamental concepts of healthful living which were of importance for general education at the secondary level, grades 9–12 inclusive, and to rank those concepts in descending order of relative importance. In pointing out the implications of the findings of his study, Staton remarks: (**15:** *p. 96*)

> The fundamental concepts of healthful living determined by the study may well prove valuable to teachers of health in the secondary schools; to persons engaged in the training of teachers of health and physical education at the secondary level; to high school health councils or committees concerned with the building or revision of a health instructional course; to persons conducting research in the secondary school curriculum; to the authors of textbooks, workbooks, and other health teaching materials for secondary school pupils; and to the producers of health instructional films for high school use.

Merrill (9) conducted research similar to that of Staton, except that it was conducted for the elementary school level. He comments that, "the identification and determination of concepts of healthful living represent the first step in the series of activities that lead to unit organization at the Elementary Level" (**9:** *p. 106*)

There have been previous studies in relation to the problem of the establishment of course content in health instruction. These, however, were not

conducted along the same lines as the studies on principles in science education and those by Staton and Merrill on concepts in health education.

Development and Status of the College Health Program. According to "*Health Education*" (7) the teaching of college hygiene was dominated up until the late 1920's by the lecture type course which was very unpopular.

The first really comprehensive survey of college health programs was that undertaken during 1922–27 by the President's Committee of Fifty. The report of this group covered over 400 institutions of higher learning and the findings indicated that health service and health instruction were far from adequate (16).

In 1935–36, the United States Office of Education made an extensive study of health instruction (12) and health service (13). In general, the same shortcomings in health instruction were found as were reported by the President's Committee of Fifty.

In 1935 the American Council on Education organized the American Youth Commission for the purposes of studying the problems of youth. One of the objectives was to investigate the health problems of youth in order to learn how young people may increase their health assets and reduce their health liabilities. The method of study of the Commission in regard to the health of college students was reported by Diehl and Shepard (5). The report indicated that the greatest single factor relating to the progress of hygiene programs was lack of adequate preparation on the part of those called upon to teach (**5:** *p. 72*).

As a result of the initial efforts of the President's Committee of Fifty, three national conferences took place in 1931, 1936, and 1947. It was reported in the Proceedings of the Second National Conference that, " . . . it is apparent that what college students know and do about health is a matter of speculation." (**11:** *p. 92*)

As a method of preparation for the Third National Conference, the Planning Committee issued a questionnaire patterned somewhat the same as that used by Diehl and Shepard in the American Youth Commission Study for the American Council on Education. An analysis of the findings of the survey indicated that college health programs had grown considerably, particularly in the area of health service. As to the status of health instruction, the following statement is significant: (**18:** *p. 126*)

> A clear picture of formal health instruction is presented for probably the first time. Not so long ago college hygiene consisted of a few lectures to first year students. Only six colleges reported that this method is still being used, while 215 reported regular curricular courses with credit.
>
> The extent of instruction varies widely according to the type of college. Teachers colleges and large publicly supported universities have the broadest teaching programs, yet even the smallest schools sometimes offer a good distribution of courses.
>
> Average total class hours per course approximate two to three semester units. Although this study of college health instruction is informative, it is far from satisfactory and can only serve as a challenge to further detailed study of this important problem.

One entire section of the Conference Report is given over to the problem of Health Education for college students. The following material indicates the viewpoints of the committee on health education: (**18:** *p. 43*)

The majority of the committee disapproved of the term "hygiene" and approved the term "personal and community health," as related to the basic or general course for all college students.

Opinions indicated that this general course should be required of all undergraduate students, but that this might be adapted to meet particular needs of special students. Students who are found to meet minimal requirements because of previous instructional experience might select alternate courses in the health field as a means of fulfilling requirements.

The committee unanimously agreed that the regular academic credit should be given for satisfactory completion of this course, that a minimum of 45 class hours or three or four semester credits be accorded, and that class size be limited. It was agreed that the course should not be administered in connection with other courses, such as physical education.

A subcommittee made recommendations that teaching method should include lectures, class discussion, personal conference, use of audio-visual aids, and problem-solving devices. They suggested the following units of instruction (but not necessarily in this order of presentation): (**18:** *p. 44*)

Nutrition, motor activity, education for family living, hygiene, mental hygiene, sense organs, effects of external factors on the body, control of communicable diseases, other major health hazards, community organization in the field of health, evaluation of community health services, significance of the periodic health examination.

This subcommittee also submitted the following objectives of this basic health course: (**18:** *p. 44*)

1. To provide a body of information concerning the functioning of all parts of the human being under varying conditions; the beneficial and detrimental factors of environment and their effect upon the body; ways in which these environmental factors may be utilized for health.
2. To induce behavior which will assist the individual to attain and maintain optimal health.
3. To develop attitudes which will lead the individual to cooperate with community and group programs for health protection.

Logical Analysis and Method of Procedure

LOGICAL ANALYSIS.

The study was divided into two major phases: (1) the determination of concepts of healthful living which might well serve as a basis of instruction for a general course in college health through a careful analysis of college health textbooks, periodicals, and vital statistics; and (2) the determination of the scientific accuracy and relative importance of each of these concepts by means of authoritative ratings of selected national leaders in health education.

RESEARCH PROCEDURE.

Phase One: The first major phase consisted of an analysis of suitable sources in order to obtain a valid list of fundamental concepts of healthful living suitable for use in a general course in college health. This phase consisted of three sub-problems:

1. The first source of concepts consisted of an analysis of thirteen selected college health textbooks, including:

ACKERMAN, LLOYD, *Health and Hygiene*, New York: Roland Press, 1943.
CHENOWETH, L. B., *Introduction to Personal Hygiene*, New York: Crofts Co., 1947.

CHENOWETH, L. B., AND MORRISON, C., *Community Hygiene*, New York: Crofts Co., 1947.
DIEHL, HAROLD S., *Elements of Healthful Living*, New York: McGraw-Hill C[illegible]949.
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LAPORTE, WILLIAM R., *Hygiene and Health*, Los Angeles: Parker Co., 1945.
MEREDITH, FLORENCE, *Hygiene*, Philadelphia: Blakiston Co., 1941.
MEREDITH, FLORENCE, *The Science of Health*, Philadelphia: Blakiston Co., 1942.
TURNER, C. E., *Personal and Community Health*, St. Louis: Mosby Co., 1948.
VAN BUSKIRK, E., *Principles of Healthful Living*, New York: Dryden Press, 1948.
WILLIAMS, JENNIE, *Family Health*, Chicago: Lippincott Co., 1945.

The criteria used for the identification of a concept were basically similar to those used by various investigators of science principles and by Merrill in his study of health concepts at the Elementary level. The criteria included:

1. Must be a comprehensive generalization or a part of a comprehensive generalization.
2. Must not be a definition.
3. Must be true without exceptions within the limitations specifically stated.
4. Must be stated definitely and/or implied in the writings of the author.
5. Must not deal with specific substances.

A careful page-by-page analysis was made of the 13 textbooks. Each concept which met the established criteria was written on an 8 x 11 sheet along with the exact book and page reference. The concepts for each text were added in sequential page order. Thus, a series of sheets represented the concepts derived from a particular text. The same procedure was used for each text. If any doubt existed as to whether or not a concept fulfilled the criteria, it was included subject to later consideration.

2. The second source of concepts consisted of an analysis of 36 issues covering the three-year period 1947–49 of the following arbitrarily selected monthly magazines: *Hygeia*, *Woman's Home Companion*, *Ladies Home Journal*, *Coronet*, *Readers Digest*. With the exception of *Hygeia* (now entitled *Today's Health*), which is published by the American Medical Association for the lay individual, the other magazines were listed among the top six monthly magazines having a circulation of more than 2,600,000 according to the 1950 edition of Ayer's *Directory of Newspapers and Periodicals* (1).

3. The third source of concepts consisted of an analysis of the vital statistics issued by the Federal Security Agency, United States Public Health Service, National Office of Vital Statistics, Washington, D. C.

The same criteria were utilized for the determination of all concepts. A final list of concepts was established by means of analyzing all concepts to eliminate duplications, combine related statements where possible, and improve wording where it was needed. The concepts were then arbitrarily arranged in the final list according to topical areas.

As a means of checking the frequency of the concepts as found in the 13 selected textbooks, two investigators, Tamoosh (17) and Walsh (20), used the final list of concepts derived in the first phase of this study. As this investigator worked closely with them and because their efforts represent an important supplement to this particular study, some significant implications of their findings are reported in the conclusions of this study.

Phase Two: The purpose of the second phase was to determine the scientific accuracy and relative importance of each concept for a general course in college health. This phase consisted of three sub-problems.

1. The final list of concepts, arbitrarily arranged according to topical areas, was submitted to a selected group of national leaders in health education for determination of their scientific accuracy. The specific instructions given and the criteria to be used were as follows:

Please read the following list of concepts with these specific criteria in mind

ARE THESE CONCEPTS SCIENTIFICALLY ACCURATE AND CONSISTENT WITH CURRENT AND ACCEPTED MEDICAL KNOWLEDGE AND RESEARCH?

Any concepts which do not meet the criteria should be, if possible, reworded so that the criteria can be met. If however there are any concepts which cannot meet the criteria regardless of any correction, they should be so indicated by crossing out the concept so that it can be deleted from the final list.

If any of the concepts should possibly appear to be duplicated in meaning although the wording is different, please so indicate by crossing out the more poorly written concept and writing beside it the number of the other concept involved.

The committee members were selected on the basis of leadership in college health education as evidenced by their contributions to the Third National Conference on College Health, numerous publications, and service on national committees in health education. The committee included:

Dr. Laurence B. Chenoweth, M.D., Professor of Hygiene, University of Cincinnati
Dr. J. W. Armstrong, M.D., Head of the Department of Hygiene, Berea College, Berea, Kentucky
Mr. Melbourne Murphy, M.S.PH., School of Public Health, University of Michigan
Dr. Warren E. Forsythe, M.D., Director of the University Health Service, University of Michigan
Dr. Louis Burnett, M.D., Chief, Physical Medicine, Veterans Hospital, Dayton, Ohio. (Formerly of the University of Maryland)
Dr. John Ferree, M.D., Director, Public Health, American Heart Association

On the basis of the recommendations of the committee, the concepts which were retained in the final list were considered to meet the criteria of being scientifically accurate and consistent with current and accepted medical knowledge and research.

2. The next consideration in the study was that of determining the relative importance of each of the concepts. This involved submitting the list of concepts to a selected group of national leaders in health education for the rating of each concept in terms of the relative importance for suitability for contribution to the basis of instruction in a general course in college health.

This group of leaders in health education was selected on the basis of their contributions to the Third National Conference on College Health, numerous publications, and service on national committees in health education. The committee included:

Dr. Dean M. Smiley, M.D., American Medical Association
Dr. Donald Dukelow, M.D., Consultant, Bureau of Health Education, American Medical Association

Dr. Fred V. Hein, Ph.D., Consultant, Bureau of Health Education, American Medical Association
Dr. Charles E. Shepard, M.D., Consultant in Health Education, Palo Alto, California
Dr. Ira Hiscock, Sc.D., Chairman, Department of Public Health, Yale University
Dr. Katharine J. Hawley, M.D., Director, Child Guidance Clinic, Waterbury, Connecticut
Dr. J. K. Rash, Ph.D, Professor of Health Education, Indiana University
Dr. Morey Fields, Ed.D., Professor of Health Education, New York University
Dr. Delbert Oberteuffer, Ph.D., Professor of Physical Education, Ohio State University
Dr. Leslie W. Irwin, Ph.D., Professor of Health Education, Boston University
Dr. Charles C. Wilson, M.D., Professor of Education and Public Health, Yale University

All the persons serving as raters were given a list of concepts with the integers 1, 2, 3, 4, 5 placed at the extreme right-hand edge of each concept. Specific directions for the use of the rating scale were as follows:

Please ENCIRCLE the appropriate number for the correct evaluation. Please think of the evaluation in terms of how an understanding of the concept may best prepare the individual for the health problems of adult and family living and contribute to the development of optimal functional health.

The numerical rating scale includes:

1. Not at all suited for inclusion in a general course in college health.
2. Poorly suited.
3. Neither well nor poorly suited.
4. Well suited.
5. Ideally suited.

The median rating per concept as indicated by considering the ratings of nine of the eleven participants was used to determine the descending rank-order of relative importance of the concepts for suitability for a general course in college health. (*Note:* Only nine ratings were considered, as Dr. Hiscock and Dr. Hawley acted in collaboration as also did Dr. Dukelow and Dr. Hein.)

On the basis of its median rating, then, each concept was ranked in the order of relative importance. Within each of the possible five rank areas of the list, those concepts involving the same topical areas of subject matter content were grouped together in sequential order to facilitate their use for instructional purposes.

3. In addition to the ratings of the selected national leaders in health education, it was decided to determine what ratings might be made by groups of Boston University Graduates selected by chance from the graduating classes of 1948, 1940, 1932, and 1924 of the departments of Sargent College, College of Liberal Arts, School of Education, and College of Business Administration. As it was obviously too much of a task for a lay individual to rate the entire list of concepts, it was deemed advisable to ask each person to rate only 50 concepts selected by chance from the entire list. A total of 152 persons served in this phase of the study. The med an number of ratings per concept was 22.

The instructions and rating scale used were exactly the same as those used by the selected leaders in health education. The median rating per concept was selected as the measure of central tendency in an attempt to provide a typical score for arranging the concepts in descending rank-order. Concepts were

grouped in the same manner as was used in the case of the selected national leaders in health education.

The findings of the study are presented in tabular form. The list of 308 concepts are arranged in three tables in the following ways:

(1) Table 1—The concepts are presented in rank-order of relative importance as indicated by the ratings of the selected national leaders in health education.

(2) Table 2—The concepts are presented in rank-order of relative importance as indicated by the ratings of the chance-selected group of college graduates.

(3) Table 3—A comparison is made of the ratings of the concepts by the selected leaders in health education and the chance-selected college graduates.

Because of space limitations only Table 3 is presented in this report.

Conclusions

Summary of the Study. The purpose of the study was to determine concepts of healthful living and their relative importance for a general course in college health. The study was organized into two main phases: (1) the determination of the concepts from several different sources including textbooks, periodicals, and vital statistics, and (2) the determination of the scientific accuracy and relative importance of each concept based on the judgments of selected national leaders in health education.

Conclusions. The following conclusions may be considered as being worthy of importance as a result of the investigation of the study:

1. The list of fundamental concepts of healthful living is composed of concepts which are scientifically accurate and consistent with current and accepted medical knowledge.

2. The list of concepts has been arranged according to their descending order of relative importance for instructional purposes for a general course in college health as best preparing the individual for the health problems of adult and family living and contributing to the development of optimal functional health.

3. From the ratings of relative importance of each concept by the selected group of national leaders in health education, it would appear that those concepts which received a median rating of four or five would be desirable for instructional purposes in a general course in college health as such a rating indicates the concept as being either well or ideally suited for inclusion in such a course.

4. The concepts of healthful living indicated in textbooks and periodicals are sometimes misleading and open to question as to their scientific accuracy and consistency with current and accepted medical knowledge and research.

5. The findings of the frequency check of the 13 selected textbooks of college health indicate that the topical areas that receive little or no emphasis include: rest and relaxation, growth and development, old age, industrial health, and safety. Those areas receiving the greatest emphasis include: disease, nutrition, heredity and reproduction, and mental health.

6. There was rather general agreement between the ratings of the selected leaders in health education and those of the chance-selected college graduates.

TABLE 3*

A comparison of the ratings of concepts of healthful living made by selected leaders in health education and chance-selected college graduates

Concepts	Ratings	
	Leaders	Graduates
1. Health is necessary for most effective living	4	4
2. Those who have the least health often value it the most	3	4
3. Health is such a personal matter that in normal times few people think of it as being of national importance	4	4
4. In spite of advances in preventive and curative medicine, faulty hygienic habits by the individual greatly influence the nation's health	5	5
5. The need for hygiene arises from the fact that we do not find ourselves in an ideal environment	4	3
6. Health concepts and practices undergo continuous change which may be progressive or retrogressive	5	4
7. Medical science is continually striving to prevent illness of all forms	4	4
8. Progress in medicine depends upon research	4	4
9. At the present time the greatest need in medical research is in the non-communicable diseases	4	3
10. Knowledge of hygiene is not sufficient; one must carry out the fundamentals of healthful living if he is to profit by it	5	5
11. Medical science has progressed tremendously in the past 75 years	4	4
12. The fundamental anatomical and physiological unit of all tissues is the cell	3	4
13. Cells vary in size and form since they have a variety of functions to perform	3	4
14. All cells contain protoplasm	3	3
15. There are only four elementary tissues: epithelial, connective (including blood and lymph), muscular, and nervous	3	3
16. The human organism is composed of several systems which include: skeletal, muscular, digestive, circulatory, reproductive, endocrinal, and nervous; all of which are functionally closely interrelated	4	5
17. The human organism consists of the progressive growth of cells to tissues to organs to systems	3	4
18. The human body is to a large extent a self-regulating mechanism	4	4
19. Clothing affects the physical and mental health, either favorably or unfavorably	4	4
20. Cosmetics are not to be regarded as a hygienic necessity	3	2
21. Skin disorders often involve emotional problems	4	4
22. Baldness may be associated with the internal secretion of some of the endocrine glands, or may be due to a hereditary sex linked tendency	4	3
23. Ordinary cleanliness is the basis of most disinfection	4	4
24. The functions of the skin are: protective, sensory, excretory, and heat regulative	4	4
25. While air is a poor conductor of heat, damp air is a better conductor of heat than dry air	2	3
26. Healthy skin, hair, eyes, teeth reflect the general health of the body and require proper diet, regular elimination, cleanliness, outdoor exercise, and adequate sleep	4	5
27. Wool fabrics are warm as they readily enclose air in their meshes, while cotton fibers do not so readily and thus are cooler	3	3
28. Light colored clothing is cooler than dark clothing as it reflects the sun's rays, whereas dark clothing absorbs them	3	3
29. A clean, neat, healthy appearance is a business and social asset	4	4
30. When glasses are needed, no other measure will suffice; and in most cases of common eye defects, glasses can make normal vision possible	4	4
31. The majority of cases of cross-eye can be corrected if treated early in life by a qualified physician	4	4
32. The most important causes of blindness are: injuries, poisons, infections, and degenerative diseases	4	4
33. Deafness is sometimes due to failure of the auditory nerve, but it is more commonly due to interference in the transmission of sound to the middle ear, due to accumulation of wax	4	4

TABLE 3—*Continued*

Concepts	Ratings	
	Leaders	Graduates
34. Middle-ear infection is the most common type of ear disease and is the chief cause of progressive deafness	4	4
35. Individuals vary in physical, mental, and emotional capacities	5	5
36. Human behavior is very complex	4	3
37. Man has the most highly organized nervous system	4	4
38. The nervous system fatigues more quickly and recovers more slowly than any other body system	4	5
39. There are two sets of bodily mechanisms that control and integrate the processes that go on within our bodies and in a large measure determine the ways in which we react to situations in our environment: the endocrine glands and the nervous system	4	4
40. Injury to the brain does not always cause mental disease	4	4
41. Both mental and physical health depend much upon a fine adjustment of the central and autonomic nervous systems	4	4
42. Subject to influences from the emotions, the autonomic nervous system controls automatically various vital processes	4	5
43. Many reflexes are innate, others are acquired	3	4
44. Brain tissue cannot be restored by surgery or medicine	3	4
45. Obstruction to breathing is one of the most common disturbances of the nose and reduces one's resistance to disease	4	4
46. Illnesses of the upper respiratory tract constitute a major health problem	4	4
47. Life is dependent upon the presence of oxygen	3	3
48. Various structural abnormalities in the mouth interfere with health, appearance, and normal function	4	4
49. Nearly one-half of the children in the United States have some type of malocclusion	3	4
50. Proper care of the teeth should be begun early in life and includes: regular dental care, proper diet, mouth hygiene	4	5
51. The proper care of the deciduous teeth is essential to the development of sound permanent teeth	4	4
52. Next to the common cold, tooth decay is probably the most common disease of man, although much of it could be avoided	4	4
53. The problem of dental caries is complex, as no single factor can be considered the cause	5	4
54. Sodium fluoride treatment in childhood may reduce dental caries considerably	4	4
55. The heart rate varies somewhat in different persons and in response to specific demands of the organism at different times	4	4
56. The blood pressure varies somewhat within normal limits according to age, physique, sex, weight, habits, and emotion	4	4
57. Blood flow depends not only on the cardiac output, but also upon the elasticity of the walls of the arteries, and the resistance offered by the capillaries to the escape of blood into the veins	4	4
58. The functions of the blood include: transfer of nutrients from the assimilation areas of the digestive system to the tissues where they are utilized; transfer of oxygen and carbon dioxide; removal of wastes of metabolism from the cells to the organs of excretion; transfer of endocrine compounds to the specific tissues which require their stimulation for proper functioning; regulation of body heat; aid in the development of immunity to disease	4	4
59. One of the most important signs of acute illness is a change from normal in the temperature of the body	4	5
60. Victims of rheumatic fever should be under constant medical supervision	4	4
61. The inter-relationship between heart disease, arteriosclerosis, high blood pressure, and nephritis is very close	4	4
62. Rh incompatibility does not mean that marriage and childbirth are necessarily dangerous	5	4
63. All living things have nutritive needs	3	4
64. Water is essential to life	3	3

TABLE 3—*Continued*

Concepts	Ratings	
	Leaders	Graduates
65. Nutritional needs vary with age, sex, climatic condition, and type of activity	4	4
66. Food supplies material which the body needs for energy, growth and repair, and regulatory controls	4	5
67. The important types of food components are: carbohydrates, fats, proteins, minerals, vitamins, and water	4	5
68. The proper diet during pregnancy is essential to the health of both mother and child	4	5
69. Vitamin deficiency may come from failure to eat the right foods regularly, failure of proper assimilation, or from loss of vitamins in the preparation or preservation of foods	4	5
70. The absence of vitamins may cause a lowered state of health, definite deficiency diseases, or even death—depending upon the degree to which they are lacking	4	5
71. Liberal amounts of protective foods such as milk and milk products, eggs, meats, fruits, vegetables should be in the daily diet, and vitamin pills should never be substituted for them	4	4
72. The diet needs to be adjusted to meet both the energy and chemical needs of the body	4	4
73. Minerals do not appear isolated in various foods but always are present in combinations	4	4
74. Foods may be made unfit to eat by various agents such as: yeasts, molds, insects, weevils, animal parasites, bacteria	4	4
75. Carbohydrates are excellent energy-producing foods and as such should make up the greater part of our diet	3	4
76. Protein is needed for growth and repair of tissues and should represent about 10–15 per cent of the total daily calories	4	4
77. Adipose tissue serves as a storage place for fats and also acts as a cushion to protect the body	4	3
78. Meal time should be at regular times, consist of appealing foods, cheerful atmosphere and environment, be free from fatigue and emotional stress	4	5
79. Children, expectant and nursing mothers, the sick, all require larger proportionate amounts of proteins, minerals, and vitamins	4	4
80. Milk is the best single food as it contains nearly all the dietary essentials	4	4
81. The older we get, the greater the hazard of excess weight which comes chiefly from overeating	5	4
82. Extensive weight reduction should be undertaken only under medical supervision	5	5
83. Maintenance of body weight means a balance between energy intake and output	4	4
84. Undernourishment is frequently the result of excessive nervous excitement, glandular disturbances, or focal infection, rather than of undernutrition	4	4
85. Optimum weight depends upon body build	4	4
86. Progress in refrigeration has greatly aided in the variety of the year-round diet	4	4
87. Better nutrition can result from wiser selection of food, better management, less waste, better meal planning, improved marketing and cooking	4	5
88. Digestion involves both mechanical and chemical effects	4	3
89. Cathartics should be avoided in case of abdominal pain	4	5
90. The most important processes in digestion and absorption take place in the small intestine	4	3
91. The excretory organs include: kidney, large intestine, lung, and skin	4	4
92. In health the constituents of the urine do not vary greatly, but some abnormal conditions can often be detected in the body by means of urinalysis	4	3
93. Probably most of those who take cathartics do not need them	4	4
94. All living cells produce waste as a result of their metabolic activity	4	3
95. The processes of growth, repair, and oxidation vary at different times and in different persons	4	4

TABLE 3—*Continued*

Concepts	Ratings	
	Leaders	Graduates
96. The endocrine glands exercise some control of the vital processes in physical and mental development and maintenance	4	4
97. The fundamental causes of glandular dystrophy are: heredity, nutrition, tumor formation, and infection	3	4
98. There seem to be inter-relationships between the various endocrine glands, and disturbances in the functions of one gland are reflected in the activities of certain others	4	4
99. The pituitary gland has been called the "Master Gland" because its effects are so widespread in the body as a whole and because it controls other glands	4	4
100. The skeletal structure provides protection and support and gives shape and form to the body	3	4
101. Skeletal muscles, using bones as levers, bring about movement through the principle of reciprocal innervation of opposing muscle groups	3	4
102. All muscle cells are contractile and tend to maintain a constant slight contraction so that heat is constantly being produced	3	3
103. Young persons need a well-balanced program of physical activity if they are to secure a well-rounded physical development	4	5
104. Healthful exercise should be regular, enjoyable, and adapted to the needs and interests of the individual	4	5
105. Postural defects may be due to heredity, disease, accidents, faulty habits, malnutrition, or fatigue	4	4
106. Poor posture may produce pain, discomfort, or symptoms of illness	4	4
107. In the correction of postural defects, the underlying causes must be determined and corrected	4	4
108. One can encourage a proper mechanical use of the body through adequate nutrition, rest, exercise, proper habits of standing, sitting, and working	4	5
109. The wearing of poorly fitted or high-heeled shoes, faulty habits in the use of the feet, and weakened muscles due to either lack of use or illness may all contribute to foot defects	4	4
110. The chances of correcting poor posture are greatest in childhood and decrease progressively with age	4	5
111. Physical activity produces many beneficial physiological effects in the body while the end results are a general improvement in health, and increased ability to resist fatigue	4	4
112. The amount of sleep required varies with the individual and with the amount of nervous and muscular expenditure	4	4
113. No satisfactory substitute for sleep can be found	5	5
114. Sleep, in order to be beneficial, must be relaxing and free from disturbing factors	4	4
115. Fatigue is one of the most common complaints that patients make to their physicians	3	4
116. The narcotic habit may be acquired accidentally through the use of narcotic-containing medicines	4	4
117. The use of coffee, tea, and tobacco by children should be discouraged	4	4
118. The problem of drinking, smoking, and the use of narcotics can best be met through education	4	5
119. In regard to medicines, the individuals who utilize the judgment of medical science are the ones who stand to profit most from them	4	4
120. Alcoholism is an important community health problem and must be viewed as an illness rather than as a moral problem	5	5
121. Artificial methods of sewage disposal involve either chemical or bacteriological purification	4	4
122. Weather and climate are among the most important of the environmental factors that affect man	3	4
123. The essentials for good lighting are that light be adequate, uniform, steady, and that glare and shadows be avoided	4	4
124. Pasteurization is the great safeguard against milk-borne diseases	4	4

TABLE 3—*Continued*

Concepts	Ratings	
	Leaders	Graduates
125. Education, accompanying legislation, and enforcement of an adequate restaurant code with respect to sanitary facilities, food storage, and food handling must be demanded by an alert citizenry	5	4
126. The problem of ventilation is to supply clean air, relatively free from disease-producing bacteria and dust, toxic and irritating fumes, at the proper temperature, relative humidity, and rate of movement	4	4
127. It is the physical and not the chemical character of air which determines its quality	4	3
128. Slum areas show higher infant mortality rates, greater frequency of disease and accidents, than other sections of cities	4	4
129. A careful examination to determine the quality of a water supply includes: study of the environment, bacteriological examination, microscopic examination, and a chemical examination	4	4
130. Methods of purifying water on a large scale include: storage, filtration, chlorination, aeration, and coagulation	4	4
131. One simple safe method of disinfecting small amounts of water is boiling	4	4
132. Sterilization may be brought about by exposing organisms to the heat of boiling water or steam, by the use of dry heat, by drying, or by the use of certain chemicals under prescribed conditions and periods of time	4	4
133. Ventilation, heating, lighting directly affect one's health	4	5
134. Unfortunately the birth rate among higher mentalities is falling off, whereas the birth rate of lower mentality groups is about 4–5 times as great as that of the superior group	4	4
135. The gestation period in the human female averages a little more than nine months	4	3
136. The more developed the child at birth the better the chance of living	4	4
137. Males as a class seem not to be able to survive as well as females, neither during fetal life nor during life after birth	3	3
138. So-called preventives and prophylactics are helpful but far from adequate in preventing either venereal disease or pregnancy	4	4
139. Emission, whether natural or self-induced, is not harmful, does not deprive the body of any substance it needs or can use, and does not weaken the individual unless it occurs to excess	4	4
140. To reproduce its kind is characteristic of all living things	4	4
141. Ovulation occurs about every 28 days between puberty and menopause	4	4
142. The menstrual process is a natural function and when it is associated with pain demands medical advice	4	4
143. The genes or their factors are the determinants of the characteristics which parents pass along to their children	4	3
144. Most of the serious hereditary abnormalities are recessive	4	4
145. The Mendelian Laws of heredity which have been discovered in plants and animals are the same as those which operate in man	4	3
146. Acquired physical and mental attributes do not alter the genes which one passes on to his offspring	4	3
147. An injury to the germ cell is much more serious than injury to the body tissues of an individual	3	3
148. Sex function follows adolescence	3	4
149. Biologically men and women want and need mating during the second and third decades of life	4	4
150. Parents should provide sex education briefly and naturally when the questions are asked and only as much as the child can understand	5	5
151. Inheritance sets the limits of development; environment and training determine how near those limits are approached	5	4
152. Immediately after giving birth to her child, the mother is extremely susceptible to infection	4	4
153. Any abortion or miscarriage is dangerous, whether accidental or induced	4	4
154. The problems accompanying illegitimacy affect mother, child, and society	5	4

TABLE 3—*Continued*

Concepts	Ratings	
	Leaders	Graduates
155. Causes of sterility are multiple	4	4
156. Most childless marriages result from involuntary sterility	4	3
157. There are two physical disqualifications for marriage and parenthood: an infectious disease that may be transmitted by either husband or wife to the other or to the child that may be born; hereditary traits that are likely to handicap their children seriously, mentally or physically	5	5
158. Four measures have been proposed for controlling the propagation of defects: education, legislation, segregation, surgery; but no one of these measures is fully satisfactory	4	4
159. Sex is the most important personal problem facing high school youth, and proper sex education for them should consider both the biological and the psychological factors	4	5
160. The change of life period involves both psychological and physiological changes	5	5
161. The fetus has its own separate blood system	4	3
162. The child with a physical handicap must learn to live with his handicap, and realize that handicaps require differences in learning, not limitations on learning	5	5
163. Visiting the doctor and dentist regularly should be begun during childhood as it is valuable in promoting desirable health attitudes and practices	5	5
164. It takes time for young children to learn new things	4	4
165. Bedtime should be a regularly scheduled time for the child	4	4
166. The largest percentage of children's fears are attributed to noises, pain, and feelings of insecurity	4	4
167. Parents should respect children as individuals and give them the independence appropriate to their maturity	5	5
168. The formation of correct habits almost from the time of birth is important to the child's physical and emotional health	5	5
169. As parents are basically responsible for the health and safety of their children, they should be aware that the major health problems of childhood are mainly communicable diseases, acute conditions, and accidents	5	4
170. Most of the skin diseases of infants are due to sensitivity or allergy	4	4
171. In general young tissues regenerate better than old tissues	4	4
172. Co-operation between the home, school, community is necessary for the wholesome development of the child	5	5
173. The progress during the first year of life is more rapid than in any subsequent year of life after birth	4	4
174. The first few weeks and months of life are the most hazardous and result in higher mortality than any corresponding period of life	4	4
175. While pregnancy is a normal experience for the mother, it taxes her system heavily; and unless she has proper medical care which considers both her physiological and psychological needs, and follows a consistent program of hygienic living, both she and the child may suffer injury	5	5
176. It is important to the health of the baby for the mother to avoid infectious disease, notably German measles, during the first few months of pregnancy, particularly the second month	5	4
177. The rate of growth and development varies widely for different children and is affected by many factors	5	5
178. Lax health examinations yearly jeopardize the future health of thousands of school children	4	4
179. Some defects like those of vision, hearing, and speech are directly related to the child's educational progress	4	5
180. The school health program includes: school health service, healthful school living, and health instruction	4	4
181. The necessity for an annual medical examination becomes of increasing importance as one reaches middle age	4	4
182. One's physician should be selected with care; the good patient respects medical science and co-operates with the doctor fully	5	5

TABLE 3—*Continued*

Concepts	Ratings	
	Leaders	Graduates
183. A person who is ill should seek competent medical care, not the use of self-medications as they only postpone finding the cause of the trouble	5	5
184. Hygienic living, periodic health examinations, wise use of medical service are sound methods in preventing the development of disease	5	5
185. Love must be made evident and not taken for granted	4	5
186. Continence before marriage is contributory to marital success	4	5
187. Single life is entirely compatible with health	4	4
188. A happy home is one in which the child experiences love, security, and affection and is essential to proper development of emotional health and maturity	5	5
189. The home is society's basic central stabilizing institution, and happy homes are the greatest single factor in personal happiness and in national strength and integrity	5	5
190. Housewives should have a functional knowledge of home nursing	4	5
191. Marriage is a partnership in the exercise of human relationships which require growth and change; and while sex is valuable, it is not the basis of marriage	4	5
192. Women, in general, are more likely to worry about their marriages and become dissatisfied than men	3	3
193. Understanding the opposite sex is not easy—as the two sexes differ biologically, psychologically, and emotionally	4	4
194. The best foundation for a happy marriage is a happy childhood in a wholesome, loving, healthy family group inspired by emotionally mature parents	5	5
195. The arrival of the first child fundamentally changes the character of marriage	4	4
196. The reasonably busy and balanced life is the wholesome life	4	5
197. Preparation for retirement should be begun early in life through the development of emotional and physical health and a wide variety of interests and activities	5	5
198. Anxiety, worry, and unhappiness are known to hasten functional decline and accelerate the process of aging	5	4
199. Married people, on the average, live longer than single or widowed persons, and are less susceptible to heart disease and mental illness	3	3
200. Older people should adjust themselves to the gradual physiological changes that embrace advancing age	4	5
201. Physiological age is not synonomous with chronological age	4	4
202. Underlying most of the disabilities of the aging process is arteriosclerosis	4	3
203. The social, economic, and medical problems associated with old age become more important each year as people live to be older	4	4
204. Psychoses caused by circulatory disorders are common in elderly people	4	4
205. Many cases of mental illness have their roots in the period of childhood, particularly in the first five years of life	4	5
206. Mental illness differs from mental deficiencies in that many cases can be cured	4	4
207. Physical defects do not necessarily mean mental defects	4	4
208. No severe mental illness ever comes suddenly	4	5
209. A significant proportion of organic mental disease is due to infection	4	4
210. All during life people have certain physiological, social, and psychological needs	3	4
211. Modern living places a strain on mental rather than physical health	4	4
212. Feeblemindedness may be acquired by heredity, congenitally, or by some accident or disease that affected the brain during infancy or childhood	4	5
213. All feebleminded people cannot be permanently segregated in institutions	4	5
214. No one is immune to mental illness	4	5
215. Mental illness is increasing and it has been estimated that one out of every 10–20 persons will someday require hospitalization for mental illness	4	4
216. Every illness involves emotional factors, since in the very nature of the human organism the physical and psychic elements are inextricably bound up together	5	4
217. Incipient and mild cases of mental disorder much more commonly involve the emotions rather than the intellect	4	4
218. The more serious mental diseases are called the psychoses and the less severe are called psychoneuroses or neuroses	3	4

TABLE 3—*Continued*

Concepts	Ratings	
	Leaders	Graduates
219. The causes of mental illness are organic or functional, and the functional type is more common	4	4
220. The mentally ill occupy about half of all the hospital beds in the United States	4	4
221. The most common psychosis involved in mental illness is schizophrenia	4	4
222. Different strains of germs vary in their virulence just as persons vary in their powers of resistance	4	4
223. Immunity is relative rather than absolute, may be innate or acquired, and acquired may be active or passive	4	4
224. Some important factors in breaking down general resistance include: fatigue, exposure to wet and cold, alcohol, malnutrition, focal infection, physical defects, previous illness	4	5
225. Germs of disease vary in the part of the body they attack and differ in their processes as well as the effects they produce on the person	4	4
226. The bodily defenses against the attack of disease-producing micro-organisms are external and internal	4	3
227. Our knowledge for the basis of immunity rests upon the study of phagocytosis, allergy, production of specific substances for combating the infection	4	3
228. Tests of immunity and sensitivity to certain specific diseases are available	4	5
229. The infant is particularly susceptible to respiratory infections and gastro-intestinal disorders	5	4
230. The principal illnesses that kill a larger proportion of women than men are: diabetes, gallbladder disease, and goiter	3	4
231. Only a small portion of those who contract poliomyelitis are crippled by it	4	4
232. Contagious impetigo is one of the most serious skin diseases of infancy	5	3
233. Chronic illness is a national health problem that affects both young and old	4	4
234. Cardiovascular diseases cause more chronic illness than any other disease	5	4
235. Heart failure and heart attacks display different symptoms, both are serious and require intelligent co-operation with the physician, but are not necessarily incompatible with considerable longevity	4	4
236. In order to combat heart disease and cancer, our leading killers, most effectively, proper diagnosis and early treatment must be made; thus people should be aware of the symptoms of these diseases	4	5
237. Rheumatic fever is the leading cause of heart disease between the ages 5–40 and chiefly involves children between the ages 5–15	5	4
238. In women cancer occurs most commonly in the uterus and the breast; in men the most common sites are the mouth, stomach, parts of the alimentary canal	4	4
239. Cancer is the foremost killer of women ages 30–54	4	4
240. Cancer kills at all ages, and the types that attack children are different from those that attack adults	4	5
241. The two most important steps in the control of cancer are: early discovery of the disease before it can spread; complete removal of the growth by surgery or radiation	5	5
242. Arthritis, the great crippler, remains one of our least understood diseases	4	3
243. Generally speaking, the diseases of middle and later life years are insidious and often the result of unhygienic living over a period of years	4	4
244. In many of the children's communicable diseases, the first symptoms are like those of the common cold	5	4
245. Autopsies save lives	4	4
246. Diseases are functional or organic, infectious or non-infectious, hereditary or acquired, acute or chronic	3	4
247. Allergies may be congenital or acquired, local or general, and many cases can be avoided by stressing certain preventive measures	4	5
248. In the process of disease a multitude of factors are usually involved	4	4
249. The common cold is the most widespread of the communicable diseases	4	4
250. The five stages of an infectious disease are: incubation period, prodromal period, period of the active disease, convalescence, recovery, and immunity	3	4

TABLE 3—*Continued*

Concepts	Ratings	
	Leaders	Graduates
251. The infected individual and his environment are controlled through isolation, quarantine, immunization, and disinfection	4	5
252. The most common ways in which pathogenic organisms are spread include: direct contact of the infected with the healthy person, drinking water polluted with the disease-producing organisms, eating contaminated food in which the organism is living, insects and other animals, handling materials used by the sick person	4	5
253. Man is the chief medium of transmission of infection both directly and indirectly	4	4
254. One should think of diseases in terms of the cause thereof, for any control must be directed at the cause	4	4
255. Disease spread by animals to man are few and are contracted in several ways: contact infection, infection from food, transmission from animal to man by means of insects, either biologically or mechanically	4	4
256. Chemotherapy has proved valuable in fighting germ diseases	4	4
257. All living things are subject to departure from normal in both structure and function	4	4
258. The shift in the relative importance in the leading causes of death in the past 50 years has been due primarily to two factors: reduction of the communicable diseases of infancy and childhood; and the increase in the average age of the population	4	4
259. The ten leading causes of death each year are responsible for about two-thirds to three-fourths of all deaths	3	4
260. Early diagnosis and treatment can cure many diseases and bodily disturbances before much harm can be done	4	5
261. The complications arising from some diseases are often more disastrous than the disease itself	4	5
262. Infant mortality is the most sensitive index of social welfare and sanitary improvement we have	4	4
263. The general treatment against insect inoculation diseases includes: prompt diagnosis and treatment of the patient under suitable isolation, a campaign against the breeding places of insects and the insects themselves, protection of the healthy population by education and cleanliness	4	5
264. Continent moral and hygienic conduct is the best protection against venereal disease	4	5
265. Pain is at times a powerful aid in preserving the life of the individual	4	3
266. Non-communicable diseases fall naturally into certain categories according to their origin or symptoms, such as: degenerative diseases, psychogenic disorders, tumors, deficiency diseases, acute poisoning, allergies, industrial diseases	4	4
267. Diabetes is common between the ages of 40–60 among those who are overweight	4	4
268. Diabetes is controllable, and diabetics can lead a practically normal life if they carefully follow the necessary treatment	4	4
269. Childbirth and diseases of pregnancy represent a leading cause of death in women between the ages 20–35	4	4
270. Pulmonary tuberculosis is a leading cause of death among young persons of ages 13–35	4	4
271. Tuberculosis is rapidly coming under control, mainly through three factors: extensive case-finding programs and prompt treatment, improvement in the standard of living, and education	5	4
272. Clearly indicated and skillfully performed surgery is a relatively small risk	4	4
273. Early ambulation often aids in convalescence from surgical operations	4	4
274. The chief cause of pre-school deaths is accidents	5	4
275. A large proportion of pedestrian accidents happen to the very young and the very old	4	4
276. Older people are particularly vulnerable to accidents, noticeably as to falls that occur in the home	4	4

TABLE 3—*Continued*

Concepts	Ratings	
	Leaders	Graduates
277. Since the baby can do nothing to protect himself, parental care and accident prevention, particularly as to asphyxiation and falling, are very vital	4	4
278. Every person should have a fundamental knowledge of first aid, and every home should have proper first aid supplies	4	5
279. As most of the sickness and accidents that occur are preventable, the key to their control is prevention	5	5
280. As teen-agers have the highest accident rate, driver education courses are badly needed in high schools	4	4
281. Education of pedestrians is as much needed as that of drivers	4	4
282. A uniform traffic code is needed in all communities, and in all states	4	4
283. As a public health problem, safety involves education, engineering, and enforcement	5	4
284. Fatal accidents consist of three major groups: home, automobile, and all others	4	4
285. The largest group of accidents, home accidents, is composed mainly of falls and burns, with the kitchen being the most dangerous room in the house	4	4
286. Among the ages 1–34 accidents of all types cause more death than any single disease	5	3
287. The medical organization of an industry has several objectives: to care for men who become sick or injured at work, to detect and correct defects which are remediable, to detect in new employees disease conditions which would endanger their lives or those of fellow workers, to make environment free from health hazards as far as possible, to educate for safe and healthful living	4	4
288. It is the duty of the state to study by observation and research the conditions of employment, to regulate conditions by careful legislation and enforcement	4	4
289. Industry, in seeking to provide healthful working conditions, must protect the employees, insofar as possible, from poisoning substances, dust, accident hazards, unsanitary environment, inadequate heating, faulty lighting, excessive noise, undue fatigue	5	4
290. The unrestricted employment of children in industry interferes with their physical and mental development; and moreover, children have been found to be more susceptible to industrial accidents and disease than adults	5	4
291. Through a better understanding of disease by the general public, by new discoveries in medical science, by better public health facilities, man is steadily lowering the incidence of disease and raising the life expectancy	5	5
292. The Federal Constitution does not give the Federal Government any specific power over public health	4	3
293. The divisions of the United States Public Health Service include: marine hospital and relief, foreign and insular quarantine and immigration, sanitary reports and statistics, domestic quarantine, scientific research, venereal disease, mental hygiene, personnel and accounts, education	4	3
294. The Federal Food, Drug, and Cosmetic Act applies only to products imported or to interstate shipment, whereas the purity of foods produced or sold within the state is controlled by special State Laws	4	4
295. Each State bears the responsibility for its health condition, and upon the State Legislature the responsibility rests primarily	5	4
296. The divisions of a typical state or local health department are flexible and generally include: communicable diseases; sanitation; tuberculosis control; vital statistics; maternal, infant, and child hygiene; public health nursing; food; laboratories; industrial hygiene; and health education	5	4
297 The best system of authority for public health administration is one which leaves the basic responsibility with local officials, but gives power to the state when local inefficiency endangers the health of the whole state	4	4
298. Those in attendance upon most communicable diseases are required by law to report to the local board of health or designated authority	4	4
299. The health of the individual is protected by proper personal hygiene and by the activities of organized government in disease prevention and medical care	4	4

TABLE 3—*Continued*

Concepts	Ratings	
	Leaders	Graduates
300. There are many voluntary health agencies at national and local levels which serve to develop those phases of health activities that official health departments cannot efficiently manage at the time	5	4
301. People should be familiar with official and voluntary agencies and the services that they provide	5	5
302. Some people cannot care for themselves and society must bear the burden	4	4
303. As the roots of juvenile delinquency lie deep in the home and community, prevention is the keynote of the control of the problem	4	5
304. Clinics such as those for marital, maternal, pediatric, geriatric, and mental health needs are vitally needed in many communities	4	4
305. Many people in rural areas lack adequate medical care	4	4
306. People must be alert to the need for legislation and enforcement of public health	5	5
307. Adequate medical care is a worldwide problem	5	4
308. The activities of the World Health Organization should help provide for improvement of world health conditions	5	4

* Because of space limitations, only Table 3 of the study is reported here.

The only concepts in which there was as much of a range as two in the median ratings per concept, that is in the difference of judgment as to the median rating per concept, were the following:

Concept	Rating	
	Leaders	Graduates
Contagious impetigo is one of the most serious skin diseases of infancy and childhood	5	3
Among the ages 1–34 accidents of all types cause more death than any single disease	5	3

7. It is believed that the determination of the fundamental concepts of healthful living represents a valuable contribution in the attainment of the objectives of college health instruction as outlined by the Third National Conference on College Health.

Recommendations for Further Research. Throughout the investigation of this study several related problems have become evident as being worthy of further research. These include:

1. The organization of units of instruction around closely related concepts.
2. A comparison of the findings of the studies of Merrill at the elementary level and Staton at the secondary level with the findings of this study to ascertain the progression of the development of concepts through the various grade levels associated with these studies.
3. An investigation to attempt to evaluate these concepts in terms of application for daily living.
4. The development of a valid and reliable test of understandings of these concepts suitable for use at the college level.

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Ability in the Standing Broad Jump of Elementary School Children 7, 9, and 11 Years of Age[1]

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HOW RELIABLY can the standing broad jump be measured on boys and girls 7, 9, and 11 years of age? What are the standing broad jump abilities of children at these ages in schools whose activity programs do not include broad jumping? These are the central questions of the present study.

The motor performance literature for the elementary school period includes several earlier studies dealing to some extent with the problems of reliably measuring and/or statistically characterizing ability in the standing broad jump. While it is not within the scope of the present report to review this literature, some cognizance of previous work is appropriate.

In investigations by Hartman (8), Jenkins (10), and Seils (15) attention was restricted to children below 9 years of age; in others by Bliss (3), Dunbar (5), and Goll (7) the subjects were above 10 years of age. Studies by Judelsohn (11) and Richards (14) covered larger portions of the elementary school period (all ages above 8 years), but the latter was on boys only. Barry (1, 2) and Williams and Hummer (17) analyzed standing broad jump data by grade rather than age, beginning with grades 4 and 5 respectively. Carpenter (4), Hummel and Walter (9), and Monohan and Hollingworth (13) used children in several grades, none of them subgrouping the children by age or grade.

Problem of the Study

The specific aims of the present study were:

1. To devise a well-controlled procedure for eliciting and measuring the standing broad jump ability of elementary school children.

2. To determine the reliability of the procedure employed. Reliability was investigated (a) from one period of testing and (b) from two testing periods separated by 2 to 5 days.[2]

[1] Acknowledgment is made to the Graduate School of the University of Oregon for a research grant in support of this study.

[2] Thorndike (16, *p. 571*) describes these approaches of reliability as (a) "to determine how consistent a measure we have of the individual as he exists at a particular moment" and (b) "to determine how consistent his performance is from day to day and week to week." He continues: "For some purposes the former may be the significant information, for some purposes the latter. If our interest lies in studying the intercorrelations among a battery of tests which have been given at one time, the appropriate measure of reliability for use . . . would seem to be a measure of consistency at that moment in time. However, if the test results are to be used for predicting something about the individual at some later date or evaluating the result of training over some extended period, the more meaningful definition of reliability would appear to be that phrased in terms of consistency over a period of time."

3. To obtain central tendency values for each sex at 7, 9, and 11 years of age and utilize these values in studying (a) sex differences at each age and (b) age changes in both sexes.

4. To characterize variability in the standing broad jump as found in each age-sex group, and thereby develop tentative "frames of reference" against which to interpret the ability of any child satisfying the basal specifications for age, background, and conditions of measurement.

Subjects

The subjects used in the study were 560 white children enrolled in 9 elementary schools of Public School District No. 4, Eugene, Oregon.[3] There were 100 children of each sex between the age limits of 6 years 9 months and 7 years 3 months, 100 children of each sex between the age limits of 8 years 9 months and 9 years 3 months, and 80 children of each sex between the age limits of 10 years 9 months and 11 years 3 months. Children were taken serially, provided they met one of the age criteria, until the desired groups of 100 (ages 7 and 9 years) or 80 (age 11 years) were obtained. The only rejections were three children registering marked pathology[4] and two children of non-white ancestry.

Apparatus

The equipment used in collecting the data consisted of a gymnasium mat, a piece of ruled canvas, a take-off platform, a yardstick, and record forms. Item 1 was a painted tumbling mat approximately 8 feet in length, 3 feet in width, and $2\frac{1}{2}$ inches in thickness.

Item 2 consisted of two thicknesses of canvas heavily cross-stitched in checkerboard fashion to minimize stretching from continued use; it was 12 feet long and 3 feet wide. This double canvas was extended over the mat with the ends folded under in order to keep the canvas taut. The area of the canvas covering the upper surface of the mat was ruled with fine transverse lines 2 inches apart. These lines were numerically identified in inch-scale units beginning at 10 inches.

Item 3, the take-off platform, was the same height as the mat with a surface 30 inches by 20 inches. It was heavily constructed to provide a firm take-off, and was used always with one 20-inch edge set against a wall.

The platform and the mat were employed as independent pieces of apparatus, i.e., the one was never in contact with the other. Hence the need for a yardstick to measure, prior to each jump, the distance from the front edge of the take-off platform to the first transverse line on the canvas.[5] Finally, record forms were ruled to give cells along each row suitable for carrying a child's name, age, sex, and successive jump measurements.

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[3] For their wholehearted cooperation in facilitating collection of the data, special gratitude is extended to Superintendent Clarence Hines and the 1950–51 principals of the Adams, Condon, Edison, Francis Willard, Harris, Howard, Lincoln, River Road, and Whiteaker schools.

[4] Two children with severe leg injuries and one child with partial paralysis.

[5] This distance was maintained at 20 or 30 inches, depending upon the age and ability of the child.

Procedure

Each child jumped barefoot, with the most distal tips of the longest toes in the same vertical plane as the front edge of the take-off platform. The jump was measured as the shortest distance from the front edge of the platform to a parallel line passing through the point of contact with the mat of whichever heel landed closest to the place of take-off. In all instances it was required that the child leave the platform with both feet together and land on the mat with both feet. Jumps rejected as unacceptable were characterized by one of the following: moving the feet either forward or backward before the take-off (e.g., flexing one or more toes over the end of the platform just prior to jumping); stepping with one foot and then jumping; touching the mat with the hand(s) previous to landing; falling backward after landing; and not landing on the feet.

Two or three children were brought to the school testing room at a time. As they awaited their turns they were asked to remove shoes and stockings, and also to discard objects regarded as possible hinderances to free jumping (e.g., sweaters worn over dresses, marbles in pockets).

Each child saw another person jump (usually a child) before being asked to take his (or her) turn. Following this visual acquaintance with the test, the child was requested to step on the platform and bring his toes up to the front edge, taking care not to get them beyond the edge. He was then instructed to take off with both feet and to jump forward as far as possible.

The testing procedure was carried out by three workers, conveniently designated S, M, and R.[6] S devoted his full attention to the child. After every new subject was in position to jump, he stood at the right of the child and demonstrated the jump alongside the mat. He then returned to the child's side and motivated by assuming the jumping position and encouraging with such words as "Jump just as far as you can. Here we go!" Following two such trials he called the child's attention to any aspect of form which he thought the child might improve upon (e.g., balance just before the take-off, manner of swinging the arms forward and upward with the jump, and/or position of the feet in landing). S continued to stimulate with assurance and encouragement until a total of 12 acceptable records (i.e., 12 jumps disregarding fouls) had been obtained on the child.

M and R served as technical assistants. Both worked on the subject's left, R alongside the mat and M in the region of the hiatus between the mat and the take-off platform. M was responsible for (a) positioning the canvas and mat between each jump and (b) watching the child's feet to see that they were not moved from the required relation with the front edge of the platform at the time of the take-off. R knelt alongside the mat and was responsible for observing the landing and recording the distance of each jump.

R, in observing the landing, and M, in measuring and adjusting the distance between the front edge of the platform and the first transverse line on the

[6] Individuals discharging the roles of S and M on different occasions were the writers and Peter T. Trim; those fulfilling the role of R were Merle M. Sigerseth and E. Matilda Meredith.

canvas, both tried to eliminate parallax error. For example, R changed position from trial to trial in an attempt to be in line with the back of the child's nearest heel at the time it touched the canvas.

The children were interested in the test and eager to engage in successive trials. Undoubtedly one factor in their high enthusiasm was novelty, arising from the fact that the standing broad jump had not been a school activity prior to the testing. At all three ages, it was evident that this was a new test for the children and one in which they (both girls and boys) enjoyed participating.

Preliminary experimentation was carried on during February 1951, and the experimental data were collected during the succeeding three months. All records were made to the nearest one-fourth inch.

Number of Trials

Reference to the previous literature for the standing broad jump on elementary school children gave no evidence of any investigator using more than 4 trials. Bliss (3), Goll (7), and Monahan and Hollingworth (13) each used 2 trials; Hartman (8) used 3 trials; Jenkins (10) used a practice trial and 3 recorded trials. Several (e.g., 1, 5, 11, 14) failed to indicate the number of trials given.

In planning the preliminary experimentation for the present study, it was thought that the child's ability in the standing broad jump probably would be manifested in a series of 4 trials. The hypothesis formulated for testing was: Ability in the standing broad jump can be determined by allowing 2 trials following a demonstration of the jump and 2 additional trials after calling attention to form components involved in a full expression of the ability.

Preliminary experimental work necessitated rejection of this trial hypothesis. It was found that when more than 4 trials were given many children jumped increasingly greater distances. Varying numbers of trials up to 20 were tried. The final choice for collection of the study data was a testing period of 12 acceptable jumps. This number was decided upon from two considerations: (1) the finding that children frequently showed improvement until after their eighth jump, and (2) the desire not to require a larger series of trials than could be carried through with the full co-operation and sustained interest of the children.

On the study subjects themselves,[7] analysis was made for the position of the best jump in the series of 12 trials. Specifically, the records for each child were tabulated with reference to whether the longest jump fell in the first third of the series, in the second third, or in the last third. Table 1 shows the percentage of children making their best record in each third of the series. It will be seen that for every age-sex group studied: (1) less than 25 per cent of the children attained their best jump in one of the first 4 trials, and (2) no less than 40 per cent gave their best performance on one of the last 4 trials, i.e., between trials 9 and 12.

Since others have used between 2 and 4 trials, it is of interest to know the amount by which the standing broad jump records of the present study exceed those that would have been obtained from no more than 4 trials. For the

[7] The children participating in the preliminary work were not included among the 560 used in collecting the study data proper.

boys, means derived from the best record in each series of 12 trials are found to surpass those based upon the best record in the first 4 trials by 2.8 inches at age 7 years, 3.0 inches at age 9 years, and 3.9 inches at age 11 years. Differences between corresponding means for the girls are 3.6 inches, 4.0 inches, and 5.0 inches at ages 7, 9, and 11 years respectively.

TABLE 1

Percentage of children attaining their best record for the standing broad jump in each third of a series of trials

Age (yrs.)	N	Trials		
		1-4	5-8	9-12
		Boys		
7	100	22	36	42
9	100	23	35	42
11	80	15	42	43
		Girls		
7	100	21	36	43
9	100	14	46	40
11	80	16	32	52

Testing Period Consistency

Interpreting reliability as consistency at one period of testing, how reliable are the standing broad jump records of the present study? The answer to this question was sought by subjecting the best and second-best records in each series of 12 jumps to two methods of analysis, the correlation method and the difference method.

Correlation findings. Treating the 6 age-sex groups separately, Pearson product-moment correlation coefficients were computed for the best record with the second best record from each series of 12 trials. The values obtained are presented in Table 2. For all three ages and both sexes, the coefficients approximate .98.

TABLE 2

*Reliability coefficients for the standing broad jump**

Sex	Age (yrs.)					
	7		9		11	
	N	*r*	N	*r*	N	*r*
Boys	100	.97	100	.98	80	.99
Girls	100	.98	100	.98	80	.98

* The best record in a series of 12 trials correlated with the second-best record.

These coefficients represent appreciably higher reliability (greater consistency) than that reported in previous investigations. Monahan and Hollingworth (13), from records for "two trials" in the standing broad jump on 90 children between the ages of 9 years and 12.5 years, secured a coefficient of .89. Seils (15), from data for an initial test and a retest after "a few hours" on 75

children between the ages of 6 years and 9 years, obtained a coefficient of .91. The differences between these values and those of the present study are greater than numerical comparison indicates: this follows since one obtains spuriously high coefficients, in dealing with an ability that increases with age, if the records for several ages are thrown together. It is inferred that the high coefficients of the present study reflect the advantage obtained by the larger number of trials used and the careful attention given to apparatus, motivation, and form.

Difference findings. The second method of analysis was that of tabulating the differences between the best and second-best jumps. For each child, the second best record in the series of 12 was subtracted from the best record. Table 3 gives the percentage of children yielding differences of varying magnitude. For the three ages taken together, the differences are less than 2 inches in 70 percent of the cases, between 2 and 4 inches in 23 percent of the cases, and between 4 and 7 inches in the remaining 7 percent of the cases.

TABLE 3

Percentage of children showing differences of varying magnitude between their best and second-best records in a series of 12 standing broad jumps*

Difference in inches	Age (yrs.)			All ages combined
	7	9	11	
	%	%	%	%
0.00–0.75	45	43	43	43
1.00–1.75	24	29	27	27
2.00–2.75	18	15	16	16
3.00–3.75	8	6	7	7
4.00–4.75	4	4	5	4
5.00–5.75	1	2	1	2
6.00–6.75		1	1	1

* Children of both sexes. The total N is 560: 200 at age 7 years, 200 at age 9 years, and 160 at age 11 years

Compared with the distance of the best jump, the second-best jump was shorter by an average of approximately one and one-half inches. The specific means for this difference were 1.5 inches on the girls aged 11 years and 1.4 inches on each of the other age-sex groups.

Day to Day Consistency

How reliable are the standing broad jump records of the present study when reliability is interpreted as consistency of performance from day to day? This question was investigated at a single age, i.e., on 75 of the subjects of each sex aged 7 years. The data utilized were the best of the 12 trials at the first testing and the best of a second series of 12 trials given 2 to 5 days later. In most instances the second period of testing occurred 2 days after the first period.

Correlation findings. Application of the Pearson product-moment method of correlation to the best records on the two occasions gave coefficients of .83 for boys and .86 for girls.

The consistency of standing broad jump records taken at intervals ranging from 1 day to 1 month has been studied on elementary school children by

Hartman (8) and Jenkins (10). Hartman retested 56 children from 1 to 14 days after the first tests were given and reported an *r* of .86. She used children between 4 and 6.5 years of age, correlating the average of 3 trials given at each testing. Jenkins correlated the best of 3 trials given at 2 testings separated by 1 to 4 weeks. Her subjects were 84 children between 5 and 8 years of age, and the *r* obtained was .82. Again attention is called to the inflationary effect on reliability coefficients produced by working with standing broad jump distributions for children dispersed in age over periods of 2.5 and 3 years.

Difference findings. Each child's best record at the first testing was subtracted from his best record at the second testing. The differences then were tabulated in three frequency distributions and converted to percentage terms. Table 4 displays the resultant percentage frequencies. Examination of the table shows: (1) approximately 50 per cent of the children did not differ in the length of their best jumps at the 2 testings by more than 2.75 inches, and (2) over 60 per cent of the children jumped farther on the second occasion than on the first.

TABLE 4

Percentage of children showing differences of varying magnitude between the best record in a series of 12 standing broad jumps at an initial testing and the best record in a like series of jumps made 2 to 5 days later*

Difference in inches†	Boys (%)	Girls (%)	Both sexes (%)
11.00 to 12.75	1		1
9.00 to 10.75	3	3	3
7.00 to 8.75	4	9	7
5.00 to 6.75	14	8	11
3.00 to 4.75	18	13	15
1.00 to 2.75	20	23	21
.00 to ±0.75	13	16	14
−1.00 to −2.75	17	19	18
−3.00 to −4.75	8	8	8
−5.00 to −6.75	1	1	1
−7.00 to −8.75	1		1

* Seventy-five children of each sex ranging in age from 6 years 9 months to 7 years 3 months.
† Obtained by subtracting the best initial record from the best retest record.

The finding of a tendency for the children to jump a greater distance on the second occasion than on the first was given further quantification by calculating the average amount by which the best records from the second testing exceeded those from the first. It was found that the retest means were higher by 1.7 inches for the 75 boys and 1.4 inches for the 75 girls.

The increase in distance jumped at the second testing harmonizes with the trend obtained by Fannin (6) in a study of "the learning curve in standing broad jumping." Her data were collected on a single adult who engaged in repeated jumping for 10 minutes each day. The subject, presumably someone who had not practiced the activity previously, showed substantial improvements in ability during the first few days, to wit: the best daily records increased by 7 inches between the first and second days, 5 inches between the second and

third days, 2 inches between the third and fourth days, and lesser amounts thereafter.

Central Tendency

The problems considered so far have been essentially methodological in character. This section and the one that follows deal with the second major purpose of the study, that of providing a statistical description of ability in the standing broad jump for boys and girls 7, 9, and 11 years of age with no previous training in the jump.

Here, the objective is to report central tendency values on the 6 age-sex samples and examine them with respect to sex and age differences in the ability portrayed. The basic data are the best records made by the 560 subjects on their initial series of 12 acceptable jumps. Table 5 assembles the obtained means for the 6 subgroups.

TABLE 5

Means for the standing broad jump on samples of white elementary school children studied at Eugene, Oregon, in the spring of 1951*

Sex	Age (yrs.)					
	7		9		11	
	N	Mean	N	Mean	N	Mean
Boys	100	41.6	100	49.8	80	59.8
Girls	100	39.9	100	47.7	80	53.4

* The data represent the best records (in inches) from a series of 12 acceptable trials for each child. The children had not had previous training in the jump.

Sex differences. At each age the obtained means are higher for the boys than for the girls. They are higher, as can be seen in Table 5, by 1.7 inches at 7 years, 2.1 inches at 9 years, and 6.4 inches at 11 years. Application of an appropriate test of statistical significance revealed that the differences are not significant at 7 years ($t = 1.8$), significant at the 5 percent level of confidence at 9 years ($t = 2.2$), and significant at the 1 percent level of confidence at 11 years ($t = 5.0$).

The lack of a clear sex difference at age 7 years is compatible with findings at the lower elementary school ages by Jenkins (10) and Seils (15). For groups of children representing ages within the period from 6 years to 7.5 years, the latter found no indication of a systematic sex difference, while the former obtained means higher for boys than girls by slightly more than an inch. Turning to the increase in amount of sex difference between 9 years and 11 years, this accords with Judelsohn's (11) findings at the upper elementary school ages.

Age differences. For the 100 boys studied at age 7 years, the mean of their best records in the series of 12 acceptable jumps is 41.6 inches. Corresponding means for the samples of boys representing ages 9 years and 11 years are higher by 8.2 inches and 18.2 inches respectively (see Table 5). For the 100 girls aged 7 years, the mean is 39.9 inches. Comparable means at 9 and 11 years, respectively

exceed this age 7 average by 7.8 inches and 13.5 inches. For the period from 7 to 9 years, the increase in means approximates 8 inches on both sexes; between 9 and 11 years, it is larger for the boys (10 inches) and smaller for the girls (less than 6 inches).

The means of the present study should be recognized as applying to ability in the standing broad jump under the specified conditions of procedure and subject background. Perhaps the most cogent way to emphasize these conditions is through the use of illustrative comparisons.

Seils (15) studied the standing broad jump ability of 118 children 7 years of age (55 boys and 63 girl between 6 years 7 months and 7 years 4 months) drawn from "the public schools of four Massachusetts communities." His mean of 36.1 inches, representing the "best response of each child," is more than four inches lower than the combined mean for the children of both sexes aged 7 years in the present study. Undoubtedly this difference reflects dissimilar procedures, e.g., fewer trials and/or less facilitating circumstances in the Massachusetts testing.

The ability of Philadelphia public school children having frequent opportunity to practice the standing broad jump during their daily physical education periods was investigated by Judelsohn (11). Judelsohn's mean of 61.0 inches on 370 boys and girls representing age 11 years, in comparison with the mean of the present study for like-age children of both sexes, is higher by over four inches. The opportunity for previous practice, without question, had served to bring the abilities of many of Judelsohn's subjects to somewhat advanced positions on "the learning curve in standing broad jumping."

From the standpoint of definition of measurement, the means in Table 5 represent the shortest distance from the distal ends of the longest *toes* at the time of take-off to the site of landing of whichever *heel* gives the smaller measurement. It follows that the displacement of the body—or, in jumps where the feet do not land in equivalent transverse alignment, the displacement of the foot travelling the shorter distance—is greater than the measurement taken. By reference to means for length of the foot at 7, 9, and 11 years of age (12), the means of Table 5 can be adjusted to approximate the full amount of horizontal displacement that the children achieved. Expressed to the nearest whole inch, the boys' adjusted means are 49 inches at 7 years, 58 inches at 9 years, and 69 inches at 11 years. Adjusted means for the girls are 47 inches, 56 inches, and 63 inches at 7, 9, and 11 years respectively.

Variability

Do the best records of the 560 subjects scatter over a wide range or cluster within a narrow one? For a specific age-sex group, are the individual differences in ability concentrated within a few inches or dispersed over several feet? How much overlapping is there of the standing broad jump distributions for the three ages, e.g., do the 10 percent of children who made the longest jumps at age 7 years have better records than the 10 percent who made the shortest jumps at age 11 years? The analyses which follow enable one to answer questions of this order.

A method of variability analysis was selected that would fulfill the twofold aim of (a) describing the obtained differences in ability within each age-sex group and (b) providing tentative "frames of reference" convenient for use with white elementary school children meeting the stated particulars of age, standing broad jump background, and procedure in testing. Application of the method involved three steps. First, the records of each age-sex group were arranged in serial order. Next, 6 values were obtained from each ordered series: the minimum; the 10th, 30th, 70th, and 90th percentiles; and the maximum. Finally, these values were used to delimit 5 normative categories.

As shown in Table 6, the categories were designated: Short jump, Moderately short jump, Average jump, Moderately long jump, and Long jump. The minimum records and the 10th percentiles furnished the limiting values of the "Short jump" category, the 30th and 70th percentiles the limiting values of the "Average jump" category, the 90th percentiles and maximum records the limiting values of the "Long jump" category.

Inspection of Table 6 will show that the successive categories constitute a five-fold sectioning of each series of ordered records, a sectioning which groups together the lowest 10% of the records, the next 20%, the middle 40%, the next 20%, and the highest 10%. To illustrate: Of the 100 boys aged 7 years, the poorest 10% jumped between 23.3 and 31.9 inches, the next 20% between 32.0 and 38.3 inches, the middle 40% between 38.4 and 45.9 inches, the next 20% between 46.0 and 49.4 inches, and the best 10% between 49.5 and 54.8 inches.

TABLE 6

Tentative norms for the standing broad jump applicable to white elementary school children with no previous training in the jump*

Age (yrs.)	Short Jump	Moderately Short Jump	Average Jump	Moderately Long Jump	Long Jump
Boys					
7	23.3–31.9	32.0–38.3	38.4–45.9	46.0–49.4	49.5–54.8
9	31.3–40.5	40.6–46.6	46.7–53.2	53.3–58.1	58.2–63.5
11	38.3–50.2	50.3–54.2	54.3–66.1	66.2–71.0	71.1–77.5
Girls					
7	24.0–30.7	30.8–36.5	36.6–44.2	44.3–47.4	47.5–56.0
9	30.3–39.1	39.2–43.7	43.8–51.2	51.3–56.8	56.9–66.3
11	39.0–43.4	43.5–49.5	49.6–57.3	57.4–63.8	63.9–68.5

* The basic data are the best records (in inches) from a series of 12 trials per child on 560 children studied at Eugene, Oregon, in the spring of 1951.

Summary

Study is made of the standing broad jump ability of 560 elementary school children lacking previous training in this jump. The subjects are 100 children of each sex representing ages 7 years and 9 years, and 80 children of each sex representing age 11 years. They are drawn from the elementary schools of Public School District No. 4, Eugene, Oregon.

Rigorous attention is given to testing equipment and procedure. The provisions regarding demonstration, motivation, and precision of measurement are

described. Findings are reported for three methodological problems: number of trials, testing period consistency, and day by day consistency.

The abilities of the children of each age-sex group are described with reference to central tendency and variability. Age and sex differences in central tendency are discussed, and variability is described using an approach that yields "frames of reference" against which to interpret the abilities of children 7, 9, or 11 years of age meeting the basal specifications in background and conditions of measurement.

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An Analytical Frequency Study of the Content of the *Research Quarterly*, 1930—1949[1]

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THE problem encompassed by this research was an analytical frequency survey of the content of the RESEARCH QUARTERLY, the official professional and technical periodical of the American Association for Health, Physical Education, and Recreation. The study was an attempt to determine the following:

1. The relative emphasis placed on research in the various areas of the broad field of health-physical education-recreation-safety by workers in the field and other interested people, based on the studies published in the one representative research periodical of the profession.
2. The relative representation of contributors, sponsoring institutions, and geographical areas.
3. A body of information which would reveal the importance of different areas of thought in the selected field, in so far as the RESEARCH QUARTERLY was a valid criterion for judging this importance.
4. The realms of thought explored by the leading research workers in the profession which might be of curricular significance to those primarily charged with teacher-training in our institutions of higher learning.

Representativeness of the Research Quarterly

The RESEARCH QUARTERLY is the sole official research publication of the American Association for Health, Physical Education, and Recreation and represents the unique research voice of this organization. The RESEARCH QUARTERLY, by its very nature, purports to publish research articles and represents a cross-section of the efforts of those physical educators actively interested in research and of other people in allied fields who have produced findings of particular interest to those in the broad field of health-physical education-recreation-safety.

Method of Attack

The analytical frequency survey, one form of the normative survey technique, was utilized in this study. A review of related research in allied fields indicated that the analytical frequency survey technique was valid and reliable for research studies of this type.

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[1] An abstract of a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Physical Education in the School of Health, Physical Education, and Recreation, Indiana University, 1951.

Data Used for Analysis

The data for analysis were limited to the 88 issues of the RESEARCH QUARTERLY published during the 20-year period, March 1930–December 1949, inclusive. The 20-year period was broken into four equal periods in order to facilitate the treatment of data and interpretations. The first period (1930–1934) was characterized by the economic depression; the second period (1935–1939) was the prewar period; the third period (1940–1944) was the war period; the fourth period (1945–1949) was the postwar period. The analysis covered 1,088 articles with 779 different authors. Certain types of content, such as Research Abstracts and Book Reviews, because the nature of their make-up would have yielded biased findings, received special treatment or were omitted completely.

Technique of the Research

Every article in the RESEARCH QUARTERLY for the period of the study was given a preliminary, cursory reading. A tentative list of 58 topical categories was subsequently changed, modified, and finally reduced to 30 for classification purposes. Eleven fields and combinations of fields and seven areas of thought, in addition to the 30 topics, were utilized in the over-all classification scheme. A code card (see Figure I) was devised and used to gather the data. This code card was planned with the idea of later using the International Business

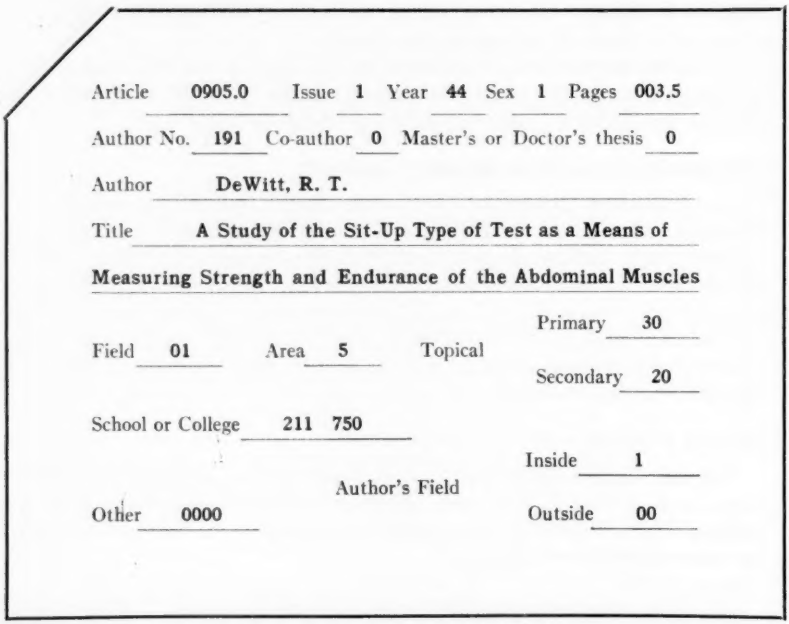

Fig. I. Code Card for Collecting Data.

Machines for sorting and tabulating. Approximately 1300 code cards were necessary, as each author of every article was given a separate card.

Analysis of the Data

The content of the RESEARCH QUARTERLY was classified by fields, by areas, and by topics, the latter under both a primary and secondary emphasis. For the most part, the analysis dealt with the following phases of the data.

1. Geographical representation—by states, districts, countries.
2. Volume of content in pages.
3. Relative representation of the sexes.
4. Persistency indices.[2]
5. Rank by author point score.

Conclusions

The following conclusions were based on an analysis of the content of the RESEARCH QUARTERLY. It is not practical or feasible to discuss here in detail all the significant findings of the study. The reader should resort to the appropriate chapter in the author's dissertation for a more complete discussion of these findings.

Field classification. By far the greatest number of articles was written in the physical education field. As is shown by Figure II, approximately 72 per cent of all articles contributed to the RESEARCH QUARTERLY fell into this category. Massachusetts was the leader in producing articles in this particular field, contributing one out of every seven articles in this classification. California led all other states in contributing articles in the recreation field.

The Eastern District was the leading district in the production of actual number of articles. However, when the population index[3] was considered, the Central District became the leader. (See Figure III.)

The physical education field was accorded some 68 per cent of the total volume of the RESEARCH QUARTERLY. Far behind in second place was the combined field of physical education-health, with approximately 10 per cent of the total volume.

Men dominated the writing in the RESEARCH QUARTERLY by a ratio of more more than two to one. Women writers increasingly and consistently tended to become more represented in other than the physical education field from time period to time period.

Five fields—physical education, physical education-health, general, health, and recreation—had persistency indices of 40 per cent or more. The physical education field was represented in every one of the 88 issues analyzed in this study.

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[2] The "index of persistency" was obtained by dividing the number of issues of the *Research Quarterly* in which a particular topic, area, or field was treated or an author represented by the total number of issues in the specific period being analyzed. This index was converted to a percentage.

[3] The population index, a device designed to show the contributing power of geographical areas, was determined by dividing the number of articles sponsored by a particular state or district by the percentage of national population for that state or district.

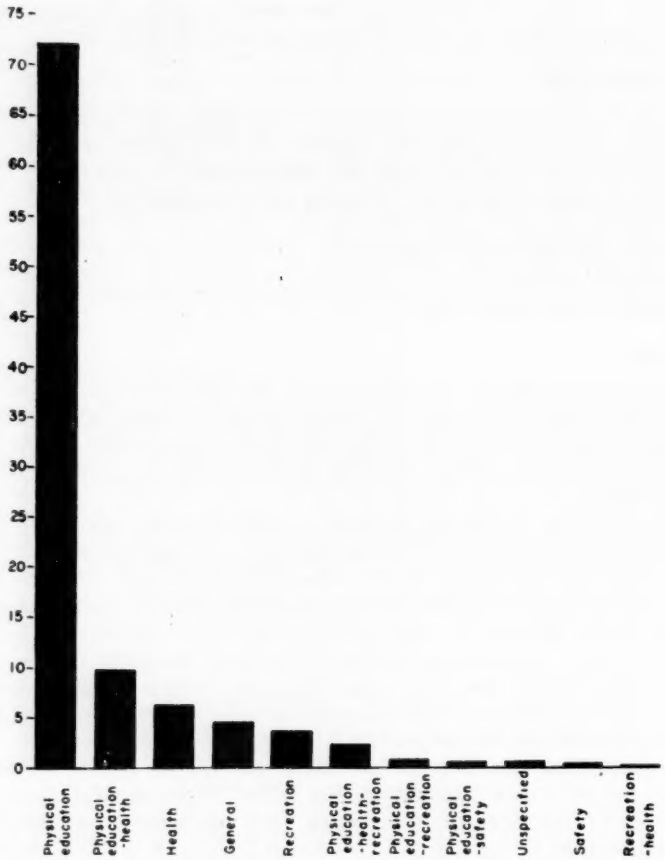

Fig. II. Percentage Representation by Fields of Articles Produced by Districts in the *Research Quarterly* during the Twenty Year Period (1930–1949).

Leading authors in the various fields were determined. H. F. Kilander was the top health author, while T. K. Cureton led those individuals writing in the physical education field. Three women—Aileen Carpenter, Anna Espenschade, and M. Gladys Scott—wrote frequently in the physical education field.

Area classification. The content of the RESEARCH QUARTERLY was broken down into seven generally accepted areas of thought. These were documental, educational, historical, philosophical, physiological, psychological, and sociological.

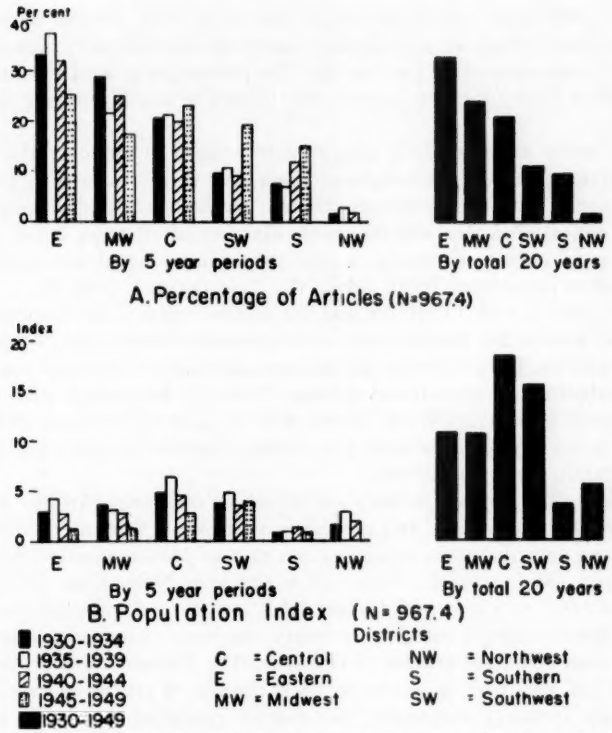

Fig. III. District Output of Articles in the *Research Quarterly* by Periods of Time According to Percentage of Articles and Population Index.

Massachusetts led in production of documental articles, articles chiefly of a bibliographical nature. The District of Columbia was the leader when the data were considered in light of the population index.

A preponderance of the articles were classified in the educational category. Forty-two states contributed approximately 735 articles, roughly two-thirds of all the articles in this area produced during the 20-year period. New York, California, and Massachusetts were the three leading states in this respect. On the basis of the population index, Iowa was the definite leader.

Pennsylvania led in the production of historical articles, Massachusetts in the production of philosophical and physiological articles, and Illinois in psychological articles. No state produced more than one article classified in the sociological area.

The Eastern District led in producing gross number of educational articles, but, once again, on the basis of the population index, the Central District was the leader.

Over 7,000 pages (65.79 percent of the total) were devoted to educational articles. Far behind in second place came the physiological area with 1,460 pages. It was interesting to note that the philosophical area reached its peak production during the first period, only to decline steadily during the ensuing periods.

Men wrote in the ratio of approximately three to one over the women in the physiological and philosophical areas and in the ratio of approximately two to one in the documental, educational, psychological, and sociological areas.

The educational area was the most persistent of all areas, being well represented in all periods. Contrary to expected findings, the physiological area had its smallest persistency index during the "war period", 1940–44.

G. B. Affleck with 13 articles was the leading writer in the documental area. Four per cent of the contributors in the educational area wrote over 22 per cent of the articles. T. K. Cureton led the men and Aileen Carpenter the women in the production of educational articles. Peter V. Karpovich with an author point score[4] of 8.83 and W. W. Tuttle with an author point score of 8.17 led all others in the physiological area. Two women, Pauline Hodgson and Frances A. Hellebrandt, made the top ten.

Topical classification (*primary and secondary emphasis*). Articles were classified from both a primary and secondary standpoint. Separate and joint treatment were accorded these emphases. Six states—Massachusetts (38.0 articles), California (35.7 articles), Iowa (31.5 articles), New York (30.5 articles), Indiana (18.7 articles), and Illinois (16.0 articles)—dominated the tests and measurements topical category (primary emphasis), producing approximately 60 per cent of all the articles of this type. The Eastern District either led or tied for the leadership in producing gross number of articles in over half of the 30 topics (primary emphasis). No district produced articles in all topical categories.

Tests and measurements with 2,552.2 pages (23.38 per cent), bibliographical studies with 972 pages (8.90 per cent), physiology and anatomy with 811 pages (7.43 per cent), and curriculums and programs with 780 pages (7.14 per cent) were the first four topics in order of volume of content over the 20-year period.

The tests and measurements category led in number of articles in every period. Philosophy, facilities, rhythmics and the dance, and intramurals all received approximately 70 per cent of their total attention during the first period.

A higher percentage of women than men wrote articles concerning tests and measurements (primary emphasis). In only three categories—biography, rhythmics and the dance, and organizations—did women actually outnumber men authors.

Tests and measurements led all topics in persistency with a persistency index of 90.0 for the 20-year period. Next in line was the physiology and anatomy category with a persistency index of 60.2. The average persistency index for the 20-year period was 24.7. Sixteen authors (7 per cent of the con-

[4] The term "author point score" refers to a consideration of article contributions by a writer, both as a single author and as a co-author.

TABLE 1

Leading Authors According to Persistency of Writing in the Research Quarterly *during the 20-Year Period (1930–49)*

Rank	Author	Number of Articles by Years																			Author Point Score	Volume in Pages	Persistency Index
		1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949			
1.5	McCloy, Charles H.	2.0	3.0	2.0		3.0	3.0	.5	1.0	1.0	1.0	1.0	1.0					1.0	.5			20.0	307.5	23.86
1.5	Tuttle, W. W.	1.0	1.5	1.3	.5		2.0			.5	.8	.8	1.0	.5	1.5	.5					.3	12.2	186.0	23.86
3	Cureton, Thomas K.	2.0	1.0		.5		3.8	1.0			2.0	2.0	5.0	1.0	1.3	1.0	.8		.5		1.0	22.9	457.0	21.59
4	Cozens, Frederick W.	1.0	4.0	1.0	1.0	.5	.5	1.3	1.0	1.0		1.0							1.0		.5	13.8	146.0	17.04
5	Affleck, George V.	1.0	2.0	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0									14.0	394.5	15.91
6	Karpovich, Peter V.				1.0	1.0		2.0		1.0	1.0	.5	5.0	.5				.8			.5	13.3	122.0	13.64
7	Larson, Leonard A.						1.5		.5			1.5	3.0					1.0	1.0	1.0	1.0	10.5	207.0	12.50
8.5	Carpenter, Aileen								1.0	3.0		1.0	2.0	2.0	1.0							10.0	94.5	11.36
8.5	Scott, M. Gladys			.5							1.0	1.0	2.0		1.0		1.3			.5	.5	7.8	114.5	11.36
10	Hewitt, Jack							.5	1.0		1.0			1.0	1.0		1.0	1.0		1.0	1.0	8.5	80.5	10.23
13.5	Clarke, H. Harrison			1.0	2.0		1.5				1.0						1.0			1.0		7.5	77.0	9.09
13.5	Elbel, Edwin R.										1.0	1.0	.5					.8		1.5	.5	5.3	77.5	9.09
13.5	Espenschade, Anna							1.0				.3		.5	1.0	1.0	1.0		1.0	1.0		6.8	68.5	9.09
13.5	Hodgson, Pauline							2.0			1.5	.3				1.0	1.0	1.0				6.8	90.0	9.09
13.5	Jackson, C. O.			1.0	1.0			1.0		1.0	1.0			2.0	1.0	1.0						9.0	98.5	9.09
13.5	LaPorte, William R.	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0													9.0	198.0	9.09
18.5	Bookwalter, K. W.						1.0				1.0			.3	2.0	2.0						6.3	52.5	7.95
18.5	Brace, D. K.		2.0				1.0						1.0		1.0			1.0		1.0		7.0	56.0	7.95
18.5	Henry, Franklin M.									1.0				2.0	1.0				1.0		.5	5.5	81.5	7.95
18.5	Messersmith, L. L.		.5	.5						.5	.5	.3				1.0				.5		3.8	23.5	7.95
	Total	8.0	16.0	9.3	8.0	6.5	17.3	11.3	6.5	10.0	13.8	11.7	21.5	9.8	11.8	7.5	6.1	6.6	5.0	7.5	5.8	200.0	2932.5	12.43

tributors in the tests and measurements category) wrote 75.82 articles, representing 28.07 per cent of all the articles contributed in this topical grouping. Approximately one-third of this select group was women.

Peter V. Karpovich, with ten articles, was the leading contributor in the physiology and anatomy topical category (primary emphasis). One foreign author, Ernst Jokl of South Africa, ranked high among those who wrote about this topic.

Contributors and sponsoring institutions and organizations. The colleges and universities of the Eastern District sponsored more contributors to the RE-

TABLE 2

The Six Leading Contributors to the Research Quarterly *According to Author Point Score by Periods of Time*

Rank	Author	Number of Articles			Author Point Score
		Sole Author	Co-author	Total	
	FIRST PERIOD (1930–1934)				
1	McCloy, Charles H.	10	0	10	10.00
2	Cozens, Frederick W.	7	1	8	7.50
3.5	Affleck, George B.	6	0	6	6.00
3.5	LaPorte, William R.	6	0	6	6.00
5	Clevett, Melvin A.	4	1	5	4.50
6	Tuttle, W. W.	1	7	8	4.33
	Total	34	9	43	38.33
	SECOND PERIOD (1935–1939)				
1	Cureton, Thomas K.	6	2	8	6.83
2	McCloy, Charles H.	6	1	7	6.50
3	Affleck, George B.	6	0	6	6.00
4.5	Carpenter, Aileen	4	0	4	4.00
4.5	Karpovich, Peter V.	4	0	4	4.00
6	Cozens, Frederick W.	3	2	5	3.83
	Total	29	5	34	31.16
	THIRD PERIOD (1940–1944)				
1	Cureton, Thomas K.	9	3	12	10.33
2.5	Carpenter, Aileen	6	0	6	6.00
2.5	Karpovich, Peter V.	5	2	7	6.00
4	Larson, Leonard A.	3	3	6	4.50
5.5	Bookwalter, Karl W.	4	1	5	4.33
5.5	Tuttle, W. W.	1	7	8	4.33
	Total	28	16	44	35.49
	FOURTH PERIOD (1945–1949)				
1.5	Hewitt, Jack E.	4	0	4	4.00
1.5	Larson, Leonard A.	4	0	4	4.00
3	Espenschade, Anna	3	0	3	3.00
4	Elbel, Edwin R.	1	4	5	2.83
5.5	Cureton, Thomas K.	1	3	4	2.33
5.5	Scott, M. Gladys	1	3	4	2.33
	Total	14	10	24	18.49

SEARCH QUARTERLY than did the colleges and universities of any other district. When the population factor was considered, however, the Central District was the definite leader. City and private school authors of the Midwest District fell short by only 2.1 in author point score in matching the total for the Eastern District.

Massachusetts with 149.2 articles led all states in producing articles, followed by New York with 116.0 articles. All but six states contributed articles at one time or another to the RESEARCH QUARTERLY during the period covered by this study.

Eleven countries outside the continental United States furnished authors for this periodical.

C. H. McCloy and W. W. Tuttle, each with a persistency index of 23.86, tied for the leadership among all authors for the honor of having been the most consistent contributors to the RESEARCH QUARTERLY during the period 1930–1949. Table 1 reveals the leading authors according to persistency of writing.

No author wrote so frequently that he was ranked among the first six contributors during every five-year period (See Table 2). T. K. Cureton did make this elite group in three of the four periods, having a total author point score of 23.0 to top all authors. When the author point score, the persistency index, and the volume were all considered, Cureton, McCloy, and Affleck stood one-two-three according to average rank (See Table 3).

TABLE 3

Leading Authors According to Author Point Score Ordered by Average Rank Based on Author Point Score, Persistency Index, and Volume of Writing in the Research Quarterly *for the 20-Year Period (1930–49)*

Author	Rank According to			Average Rank
	Author Point Score	Persistency Index	Volume	
Cureton, T. K.	1.0	3.0	1.0	1.67
McCloy, C. H.	2.0	1.5	3.0	2.17
Affleck, G. B.	3.0	5.0	2.0	3.33
Tuttle, W. W.	6.0	1.5	6.0	4.50
Cozens, F. W.	4.0	4.0	7.0	5.00
Karpovich, P. V.	5.0	6.0	8.0	6.33
Larson, L. A.	8.0	7.0	4.0	6.33
LaPorte, W. R.	10.0	13.0	5.0	9.33
Carpenter, Aileen	9.0	8.5	11.0	9.50
Scott, M. Gladys	12.0	8.5	9.0	9.83
Jackson, C. O.	7.0	13.0	10.0	10.00
Hewitt, Jack E.	11.0	10.0	14.0	11.67
Hodgson, Pauline	15.5	13.0	12.0	13.50
Clarke, H. Harrison	13.0	13.0	15.0	13.67
Espenschade, Anna	15.5	13.0	16.0	14.83
Brace, D. K.	14.0	17.0	17.0	16.00
Henry, F. M.	19.5	17.0	13.0	16.50
Bookwalter, K. W.	17.0	17.0	19.0	17.67
Krakower, Hyman	18.0	19.5	18.0	18.50
Anderson, Theresa	19.5	19.5	20.0	19.67

One hundred eighty-nine institutions of higher learning in the United States sponsored authors in the RESEARCH QUARTERLY. The State University of Iowa led all others in this respect with an author point score of 75.8. The reader is referred to Table 4 for a breakdown by period of the leading colleges and universities in author representation.

A number of non-school groups sponsored authors in the RESEARCH QUARTERLY. Private and semi-private organizations produced a total of 40 authors A complete picture of the representation of outside organizations is given in Table 5.

TABLE 4

Leading Colleges and Universities in the United States in Representation According to Author Point Score in the Research Quarterly *for the 20-Year Period (1930–49)*

Rank	Institution	Author Point Score by Periods				Total Author Point Score	Percentage of Author Point Score of All Colleges and Universities
		1930–34	1935–39	1940–44	1945–49		
1	State U. of Iowa	24.3	24.5	20.0	7.0	75.8	8.88
2	Springfield College	15.0	25.0	26.0	3.5	69.5	8.14
3	U. of California (Berkeley)	0.0	8.0	10.7	16.5	35.2	4.12
4	U. of Illinois	5.0	6.0	14.3	9.0	34.3	4.02
5	Wellesley College	5.0	19.0	4.0	0.0	28.0	3.28
6	U. of California (L.A.)	7.5	9.3	3.0	1.5	21.3	2.49
7.5	U. of Michigan	7.0	8.0	5.0	0.0	20.0	2.34
7.5	U. of Wisconsin	9.0	7.0	2.0	2.0	20.0	2.34
9	U. of Minnesota	4.5	7.0	7.0	1.0	19.5	2.28
10.5	U. of Denver	1.0	1.0	1.0	14.0	17.0	1.99
10.5	U. of Southern California	8.0	6.0	0.0	3.0	17.0	1.99
12	Teachers College, Columbia U.	11.0	5.5	0.0	0.0	16.5	1.93
13	Indiana U.	0.0	2.5	7.7	6.0	16.2	1.90
14.5	College of the City of New York	0.0	4.0	9.0	2.0	15.0	1.76
14.5	U. of Texas	3.0	2.0	6.0	4.0	15.0	1.76
16	Boston U.	2.0	11.0	1.0	0.5	14.5	1.70
17.5	New York U.	5.0	3.0	1.0	4.0	13.0	1.52
17.5	Oberlin College	7.0	1.0	5.0	0.0	13.0	1.52
19	Ohio State U.	4.0	6.0	0.0	2.0	12.0	1.41
	Total	118.3	155.8	122.7	76.0	472.8	55.37

The physiologists were the leading outside field contributors to the RESEARCH QUARTERLY, having a total of 68 representations to their credit. W. W. Tuttle was the most prominent outside field author, with an author point score of 12.33 (17.18 per cent of all outside articles). Table 6 reveals the frequency with which authors representing nineteen selected outside fields have contributed to the RESEARCH QUARTERLY during the 20-year period, 1930–49.

TABLE 5

Representation of Organizations (Other Than Schools, Colleges, and Universities) in the Research Quarterly *during the 20-Year Period (1930–49)*

Rank	Sponsor	Number of Authors	Percentage of All Author Representation
1	Private and semi-private organizations	40	3.01
2	Educational sources (other than schools)	24	1.80
3	Medical and health services	20	1.50
4	Military	8	0.60
5	Miscellaneous	5	0.38
	Unlocated	28	2.11
	Total	125	9.40

TABLE 6

Frequency with which Authors Representing Nineteen Selected Outside Fields Have Contributed to the* Research Quarterly *during the 20-Year Period (1930–49)*

Rank	Outside Field	Number of Times Outside Field Represented	Percentage of Outside Representation	Percentage of All Representation
1	Physiologists	68	34.34	5.11
2	Medical personnel	43	21.72	3.23
3	Educators	29	14.65	2.18
4	Psychologists	13	6.57	0.98
5.5	Biologists	9	4.55	0.68
5.5	Unspecified	9	4.55	0.68
7.5	Military personnel	4	2.02	0.30
7.5	Physicists	4	2.02	0.30
9	Librarians	3	1.52	0.23
12.5	Architects	2	1.01	0.15
12.5	Chemists	2	1.01	0.15
12.5	Mathematicians	2	1.01	0.15
12.5	Periodical writers	2	1.01	0.15
12.5	Secretaries	2	1.01	0.15
12.5	Sociologists	2	1.01	0.15
17.5	American Red Cross worker	1	0.51	0.08
17.5	Biophysicist	1	0.51	0.08
17.5	Government worker	1	0.51	0.08
17.5	Zoologist	1	0.51	0.08
	Total	198	100.0	14.91

* "Outside fields" refers to classifications outside the broad field of health-physical education-recreation-safety.

General. The discussion in the foregoing paragraphs serves to stress the fact that the relative emphasis placed on the various areas of the broad field of health-physical education-recreation-safety was by no means evenly distritributed. Physical education definitely received the major share of the attention and efforts of research workers in the field. The field of safety was almost com-

pletely ignored by writers in so far as studies published in the RESEARCH QUARTERLY were concerned. Other fields received correspondingly little treatment.

As might have been suspected, a small group of authors, roughly two and one-half per cent, produced a sizable proportion of the articles written in this periodical. However, a total of 779 different authors contributed to the RESEARCH QUARTERLY, making this periodical a product of the efforts of many, rather than a few, interested writers. Nearly 300 secondary schools and institutions of higher learning sponsored authors in this publication, which resulted in varied styles of writing and methods of presentation of data.

The RESEARCH QUARTERLY, the technical periodical of the physical education profession, mirrors the thoughts and research efforts of the workers in the field. What has been written about in this magazine for nearly a generation must be something of permanent concern to those in the field. The attention and time devoted to the various areas of thought by research workers in the field may be assumed to be a criterion for judging the worth of a particular realm of inquiry. The findings in this study clearly indicate what areas of thought have been of greatest concern to the leading writers in the profession and, hence, should be of primary interest to curriculum makers in our teacher-training institutions.

A Study of the Relationship of Certain Physical and Emotional Factors to Habitual Poor Posture Among School Children

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EXPERIMENTATION and research indicate the widespread need for a more practical and scientific approach to the problem of posture, which will result in more effective use of the body. There is a continually increasing consciousness of the importance of efficient body mechanics. Many administrators, classroom teachers, and specialists in health and physical education have indicated an intense interest in establishing functional programs for the improvement of posture.

The relationship of posture to health, environment, athletic ability, and various other factors has been a topic of discussion for many years. Recent articles and books show a definite trend on the part of educators and members of the medical profession to consider seriously the implications of the relationship of physical and emotional factors to poor posture. Goldthwaite[1] emphasized proper training of the body, so that the best possible state of health might be obtained. He also stated that good body mechanics is a vital factor in the prevention of disease. Hansson[2] claimed that orthopedic surgeons have overwhelming evidence for the importance of body mechanics both as a preventive and a curative agent.

In 1947, Williams and Brownell[3] indicated that fear, self-consciousness, fatigue, and other physiological states are reflected in postural patterns. A year later, Irwin[4] cited a list of possible causes and contributing causes of poor posture. Lee[5] listed physical defects and environmental factors as handicaps

[1] Joel E. Goldthwaite et al, *Essentials of Body Mechanics in Health and Disease.* Philadelphia: J. B. Lippincott Company, 1945, pp. 1, 285.

[2] K. Hansson, "Posture and Body Mechanics," *Journal of Health and Physical Education,* **16:** 549; December 1945.

[3] Jesse Feiring Williams and Clifford Lee Brownell, *The Administration of Health and Physical Education.* Philadelphia: W. B. Saunders Company, 1947. p. 167.

[4] Leslie W. Irwin, Modern Trends in Posture Training, *Education,* **68:** 472, The Palmer Company, Boston, April 1948.

[5] Mabel Lee and Miriam M. Wagner, *Fundamentals of Body Mechanics.* Philadelphia: W. B. Saunders Company, 1949. p. 156.

to good posture. In Rathbone's recent text,[6] various causes of faulty development were also mentioned. Kelly[7] claimed that the removal of the underlying causes of posture defects was one of the four steps necessary for improvement of body mechanics. She listed fatigue, infection, discouragement, and physical defects as causes of poor posture. There are few studies showing tested differences between these factors and posture.

The purpose of this investigation was to study the relationship of certain physical and emotional factors to habitual poor posture among school children

Procedure

Boys and girls in 23 different elementary schools from seven different communities in Massachusetts were selected for this study. There were 250 cases of good and poor posture recommended from intermediate grades, totaling approximately 4,000 children. This preliminary sample was obtained through individual referrals by competent persons. School physicians and nurses recommended cases from their findings on medical examinations; classroom teachers selected pupils through daily observation techniques; cases were also presented through the co-operative effort of health and physical education teachers.

The range in community population was from 4,000 to 80,000. An attempt was made to include a variety of the following items: size of the school systems; number of schools in each community; geographical locations within the state; home environments in different areas of the state, as well as in the communities themselves; racial characteristics of the pupils; and economic status. Other criteria considered were the amount of interest and co-operation which could be expected from administrators, health specialists, and teachers. Owing to the fact that anatomical and physiological factors may have an influence on posture, the study was limited to children from grades four, five, and six.

The Iowa Posture Test[8] was given to each of the 250 children recommended for the study. Since no statistical evidence could be found which established the reliability or validity of this instrument, a special study[9] was carried out to reveal the reliability of the test. This was accomplished through dual but independent ratings which resulted in a reliability coefficient of 0.965. The purpose of this test was to make a general survey of all cases and to eliminate those which were not exceptionally good or poor. The distribution of these scores was then studied and the upper quarter was selected as the possible good posture cases, the lower quarter was designated as the criterion group having undesirable characteristics.

Two independent criteria were used as the final bases for the validity of the posture test. One was the initial recommendation of the pupil for the survey;

[6] Josephine L. Rathbone. *Corrective Physical Education*. Philadelphia: W. B. Saunders Company, 1949. p. 116–128.

[7] Ellen Davis Kelly. *Teaching Posture and Body Mechanics*. New York: A. S. Barnes and Company, 1940. p. 8.

[8] Mabel Lee and Miriam M. Wagner, *op. cit.*, pp. 283–286.

[9] Mary J. Moriarty, *A Study of the Relationship of Certain Physical and Emotional Factors to Habitual Poor Posture Among School Children*. Doctor's Dissertation. Boston University School of Education, 1950, pp. 48–49. (Unpublished)

the other was the result of the findings concerning the posture on a special medical examination. The child was accepted for inclusion in the study only if the rating of good or poor posture on the initial recommendation, the doctor's report on posture, and the findings of the posture test, all consistently described a given child.

After the groups had been selected at the extremes of the range in posture ratings, information concerning factors which might be related to the posture of the children was collected. Three sources of data were explored: the medical examination, the check list, and the information data sheet. Specific physical and emotional factors which were studied and the sources of data are found in Table 1.

TABLE 1

Summary of sources of data on defects and factors which may contribute to poor posture

Possible Causes	Medical Examination	Check List	Information Data Sheet
Defects			
Deformities	*	*	
Dental defects	*		*
Disease	*		*
Glands	*		
Hearing	*	*	*
Nervous system	*		
Nose	*		
Obesity	*	*	*
Skin	*		
Speech	*	*	*
Underweight	*		*
Vision	*	*	*
Characteristics		*	
Other Factors			
Lack of cleanliness	*	*	
Improper clothing		*	*
Shoes		*	*
Fatigue		*	*
Home environment	*	*	*
School environment		*	*

A medical record card was constructed for a special examination of each child. This rating instrument included all items thought to have possible bearing on the posture of the child through his health status. The initial items were selected by specialists in the area of health and body mechanics, and were chosen because they were considered pertinent to this specific study. A general practitioner, a pediatrician, and a dentist inspected and revised the initial form. Items were added if, from the medical point of view, they were considered of value in studying possible implications. The need for standardized techniques on the administration and recording was emphasized in personal interviews with the nurses and physicians. Any defect reported by the physician was considered a valid item if it was also recorded through other devices.

The check list[10] was constructed for directed observation by the classroom teacher. The range of reliability indices was from 0.49 to 1.00.[11] Seven areas

[10] Mary J. Moriarty, *op. cit.*, pp. 99–100.

[11] *Ibid.*, pp. 53–59.

were included: impaired vision, impaired hearing, speech difficulties, fatigue, clothing, deformities, and other characteristics. In addition, space was provided for informtion concerning any school or home conditions which the teacher considered indicative of emotional disturbances. Specific suggestions were listed under each main heading to assist the teacher in indicating or recognizing the defect or factor designated. The classroom teacher observed the child over a period of at least two weeks and recorded her conclusions.

The information data sheet was used as a supplementary device to check on specific data acquired from other sources, and to collect general information concerning the status of the child. These data were collected, in most cases, through personal interviews with principals, nurses, and teachers and through an intensive review of all records.

Analysis of Data

The determination of the factors to be used in the study was based on data derived from the medical examination, the check list, and the information data sheet. Complete agreement was used as a standard in both the control and the experimental groups. After applying these criteria, the ultimate sample studied included 57 cases in the experimental group and 57 cases in the control group. The fact that each had the same number of cases was the result of chance.

An analysis of each of 31 factors was made in relation to posture. Critical ratios and percentages were obtained between the experimental group and the control group. The one percent level of significance was employed to indicate whether or not the reported differences represented true differences. A complete record of the statistical findings on the 31 factors appears in Table 2.

The reported differences for disease, fatigue, self-consciousness, fidgeting, heart defects, other diseases, hearing defects, restlessness, timidity, underweight, and asthma, indicated that these factors were conclusive at the one percent level of significance.

Disease included any physical disorder which was reported on the physician's examination and verified by health reports. In order that fatigue might be considered as a factor, the findings on the medical record, the teacher's observation instrument, and the health records had to be in agreement. Self-consciousness and fidgeting were reported only through directed observation of the teacher.

Heart defects and asthma appeared more frequently than other items under physical disorders. These two diseases and the remaining diseases were given separate statistical treatment. The sources of data were the physician's medical examination and the health records. Hearing defects were considered only when there was an agreement on the three evaluation techniques: the medical examination, the check list, and the hearing test results on the health records. The children who were underweight were reported by the doctor and also on the health records.

Six of the remaining factors approached significant differences. These were: improper shoes, 2.40; deformities, 2.18; glandular defects, 2.04; speech defects, 1.95; vision defects, 1.93; and dental defects, 1.75. The other 14 factors showed no statistical differences.

TABLE 2

Statistical findings for 31 factors investigated on 57 cases in the experimental group and 57 cases in the control group

Factors	%E	%C	SEp_E	SEp_C	Diff.	SE Diff.	C.R.
1. Disease, total	42	5	.066	.029	.37	.0721	5.13
2. Fatigue	25	0	.058	.000	.25	.0580	4.31
3. Self-conscious	41	14	.066	.046	.27	.0805	3.35
4. Fidgets	35	11	.064	.042	.24	.0766	3.13
5. Heart defects	12	2	.043	.019	.10	.0348	2.87
6. Other diseases	19	3	.052	.023	.16	.0569	2.81
7. Hearing defects	12	0	.043	.000	.12	.1430	2.76
8. Restlessness	25	7	.058	.034	.18	.0672	2.67
9. Timidity	25	7	.058	.034	.18	.1672	2.67
10. Underweight	32	12	.062	.043	.20	.0755	2.65
11. Asthma	11	0	.042	.000	.11	.0420	2.61
12. Improper shoes	16	3	.049	.023	.13	.0541	2.40
13. Deformities	12	2	.043	.019	.10	.0459	2.18
14. Glandular defects	23	9	.057	.008	.14	.0685	2.04
15. Speech defects	11	2	.042	.019	.09	.0460	1.95
16. Vision defects	16	5	.049	.029	.11	.0569	1.93
17. Dental defects	49	33	.067	.062	.16	.0289	1.75
18. Environmental (Home)	23	12	.056	.0043	.11	.0713	1.54
19. Lack of cleanliness	16	7	.049	.034	.09	.0596	1.51
20. Nose defects	9	3	.038	.023	.06	.0444	1.34
21. Temper tantrums	3	0	.023	.000	.03	.0230	1.30
22. Cries easily	3	0	.023	.000	.03	.0230	1.30
23. Improper clothing	11	5	.042	.029	.06	.0510	1.11
24. Environmental (School)	9	5	.038	.029	.04	.0478	.83
25. Day dreams	16	11	.049	.042	.05	.0645	.70
26. Nervous	3	2	.032	.019	.00	.0298	.335
27. Skin defects	3	2	.032	.019	.01	.0298	.335
28. Bites nails	23	21	.057	.054	.02	.0785	.25
29. Obesity	19	18	.052	.051	.01	.0729	.13
30. Destructive	2	2	.019	.019	.00	.0270	.00
31. Cruel	0	0	.000	.000	.00	.0000	.00

Conclusions

The factors studied have been frequently cited in previous literature in connection with their possible relationship to poor posture. It has been implied that a relationship existed, but no research could be found which would indicate reliable evidence of that relationship. It was the purpose of this study to investigate the possibilities of a true relationship between these factors and poor posture.

Twenty-nine factors out of a total of 31 showed a higher percentage frequency in the experimental group. The differences between the means of the control and experimental groups is significant at better than the one percent level of confidence in 11 of the factors studied. Four of these items: disease, fatigue, self-consciousness, and fidgeting indicated highly significant differences above 3.0. It may be concluded that there is a significant association between poor posture and certain physical and emotional factors, namely: disease, fatigue, self-consciousness, fidgeting, hearing defects, restlessness, timidity, underweight, heart defects, and asthma. The need for further research is obvious and will suggest itself from the tables.

The Effect of a Cold Abdominal Spray Upon a Repeat Performance in the 440-Yard Run

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IN SETTING UP the schedule of events for a track meet, it has been the common practice to arrange the events in such a manner that a participant may run in more than one event. For this reason, it would be advantageous to a runner if a procedure could be followed during the interval between events that would enable him to run better in his second race.

It was the purpose of this study to determine whether or not a cold spray on a runner's abdomen following his competition in one race of 440 yards would enable him to perform better in a second race of 440 yards than if he ran the second race with only another warm-up preceding it.

Review of Literature

There have been, to the writer's knowledge, only three studies made on the effects of cold abdominal packs or sprays. The first of these studies was one done by Kelso, Steinhaus and Reinhardt (3), who found that a cold hip bath produced temporary improvement in visual functions, tapping rate, and eye-to-leg muscle reaction time. Happ (1), in his study using a bicycle ergometer, found that individuals did more work on the bicycle after an ice pack had been applied to their abdomens for ten minutes than after resting ten minutes following a one-minute all-out ride on the same bicycle. It was also found in this experiment that in a few cases a greater amount of work was done in the second trial after ice packs had been applied than was done in the first trial when the individuals were presumably fresh. In a follow-up study to the one above, which was done by Happ, Tuttle, and Wilson (2), it was found that: (a) recovery from fatigue resulting from strenuous exercise is facilitated by the application of abdominal ice packs; (b) that the weight of the ice had no bearing on the experiment; (c) that there was an indication that a carry-over effect of the ice application increased work output the following day; and (d) that ice packs alleviate such conditions as dizziness and nausea.

Procedure

Sixteen members of the State University of Iowa track team were selected for experimentation. These subjects were chosen to assure the completion of the running events which required good physical condition.

On the first day of the experiment for each subject, two 440-yard races were run at a maximum speed. During a 20-minute interval that was allowed between the two races, the subject was instructed to move about continuously. The times

for the two races were not disclosed to the subject until the second race was completed to ensure an all-out effort on both occasions.

Seven days later, the subject ran two more 440-yard races at maximum speed. At the end of the first race, the subject was allowed to move about for five minutes prior to the application of the cold abdominal spray. The initial temperature of the water was approximately 70°F. and was gradually lowered in five minutes to a temperature of approximately 45°F. The latter temperature was maintained for a five-minute period. Following the application of the cold abdominal spray, the subject was allowed five minutes to prepare for the second 440-yard race.

Again the times of the two races were not disclosed to the subject until the second race was completed to ensure an all-out effort on both occasions. The 16 men who participated in the experiment ran on two different days in November 1950, as indicated above. In March 1951, the experiment was repeated on eight of the original subjects.

Analysis of Data

The mean differences between the times for the various races were first computed for the 16 subjects. In order to determine the significance of these differences, significance ratios were computed. The *t* ratio formula for correlated measures was used. (See Tables 1 and 2.)

After the significance ratios had been computed for all 16 subjects, significance ratios for 8 of the subjects who ran on the third and fourth days were computed. In analyzing the 16 subjects, the significance ratio for the mean difference obtained between the first and second races on the first day of trials (no cold spray) and the mean difference obtained between the first and second races on the second day of trials (cold spray) was computed and found significant at the 5 per cent level of confidence. The difference obtained was favorable to the use of the abdominal cold spray.

The significance ratio for the first race on the first day when the cold spray was not applied and the first race on the second day when the cold spray was applied was established at the 65 per cent level of confidence. This result showed there was no significant difference between these performances and indicated that the subjects ran approximately the same speed for the initial races on two different days.

The significance ratio for the second race on the first day when the cold spray was not applied between races and the second race on the second day when the cold spray was applied between races was computed and found significant at the 2 per cent level of confidence. This result was in favor of the use of the cold abdominal spray.

When the author questioned the subjects after the completion of each day of trials, they reported that they did not feel so fatigued on the days when the cold spray had been applied between races. One subject felt good enough to run a third 440-yard race five minutes after his second race, and proceeded to run only two-tenths of a second slower than he had run the second race.

In analyzing the 8 subjects, the significance ratio for the mean difference obtained between the first and second races on the first day of trials (no cold spray) and the mean difference between the first and second races on the third day (no cold spray) was established at the 40 per cent level of confidence.

The significance ratio for the mean difference obtained between the first and second races on the second day of trials (cold spray) and the mean difference between the first and second races on the fourth day (cold spray) was established at the 65 per cent level of confidence.

The significance ratio for the mean difference obtained between the first and second races on the first day of trials (no cold spray) and the mean difference obtained between the first and second races on the second day of trials (cold spray) was established at the 85 per cent level of confidence. The difference obtained was favorable to the use of the abdominal cold spray.

The significance ratio for the mean difference obtained between the first and second races on the third day of trials (no cold spray) and the mean difference obtained between the first and second races on the fourth day of trials (cold spray) was established at the 30 per cent level of confidence. The difference obtained was not favorable to the use of the abdominal cold spray.

TABLE 1

Significance ratios for the performances of the 16 subjects

Trial	First Day	Second Day*	t	Level of Confidence
First race	55.970	56.087	0.47	65%
Second race	57.370	56.856	2.63	2%
Mean difference between first race and second race	−1.400	−0.769	2.25	5%

* Cold spray day.

TABLE 2

Significance ratios for the performances of the eight subjects who repeated the experiment in March

Trial	1st Day (November)	2nd Day* (November)	3rd Day (March)	4th Day* (March)	t	Level of Confidence
Mean difference between first race and second race	−1.0		−.787		0.97	40%
		−.938		−1.125	0.51	65%
	−1.0	−.938			0.27	85%
			−.787	−1.125	1.07	30%

* Cold spray days.

TABLE 3

Mean times for the eight subjects who repeated the experiment

Trial	1st Day	2nd Day*	3rd Day	4th Day*
First race	55.613	55.325	55.425	54.850
Second race	56.613	56.263	56.212	55.975

Cold spray days.

The significance ratios for the 8 subjects who were retested did not indicate that there were significant differences between the performances in November 1950 and those in March 1951. These results indicated that the true differences were zero (null hypothesis).

In analyzing the data on the 8 subjects, it was also seen that the mean time of the first race on cold spray days was much faster than the mean time of the first race on non-spray days (Table 3). It was concluded, therefore, that this may have been the reason for not obtaining better results on the cold-spray day, because the subjects ran much faster in the first race and consequently it was harder to show more improvement in the second race. It was also seen that the mean time of the second race was faster on the cold spray day than the mean time of the second race on the non-spray day.

Summary and Conclusions

It was found that the average time for the 16 subjects was faster for the second 440-yard race on the day when the cold abdominal spray was applied than for the second 440-yard race on the non-spray day. It was also found that the average fall-off in time for a second 440-yard race was less after a cold abdominal spray was applied between races than when a cold spray was not used between races.

For 4 of the 16 subjects following the use of the cold abdominal spray, the performances for the second race were better than for the first race. An improvement of a second performance over a first performaece never occurred when the cold abdominal spray was not used.

When eight of the original subjects repeated the experiment, there were no statistically significant differences between their scores for the first and second days of experimentation in November 1950 when compared to their scores for the third and fourth days of experimentation in March 1951. A significance ratio was established at the 30 per cent level of confidence between the performances of the eight subjects on the third and fourth days of running. Although not statistically significant, this finding did not substantiate the original findings for the 16 subjects, since the difference was found to be in favor of the non-spray day.

In an effort to account for this apparent reversal of facts, the author computed a significance ratio to compare the performances of these eight subjects on their first and second days of trials. This ratio was established at the 85 per cent level of confidence in favor of cold spray. It was apparent, therefore, that the statistically significant difference determined for the 16 subjects was influenced primarily by the 8 subjects who did not repeat the experiment.

On the basis of the evidence disclosed in this study, the following conclusions were drawn:

1. A statistically significant difference at the 5 per cent level of confidence was obtained in favor of using abdominal cold sprays when the whole group of 16 runners ran two 440-yard races with a time lapse of 20 minutes between the two races.

2. When 8 of the original 16 subjects repeated the experiment, there were no statistically significant differences obtained between their performances in November 1950 and their performances in March 1951. It was further determined that the obtained difference, which was not statistically significant, between their performances on the third and fourth days of the experiment was not favorable to the application of the cold spray.

3. Throughout all phases of the experiment, the mean time of the subjects was always faster on the race following the application of a cold spray than the mean time of the race when no cold spray was applied. This result was seen, no matter how fast the first race, in either case, was run.

4. On the basis of the statistical results of the study, the author concluded that the use of the cold abdominal spray was advantageous to some runners but resulted in no significant improvement for others. It would be advisable, therefore, for a track coach to determine which members of his squad perform better when a cold abdominal spray is applied between races.

Recommendations for Further Study

1. Use of the cold spray before the subjects warm up for their first race.
2. Use of the cold spray in warm weather and compare results to those of the present study.
3. Use of the cold spray for races of varying distances.

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The Effects of Verbal Instruction of Speed and Accuracy Upon the Learning of a Motor Skill[1]

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THE TEACHER of motor skills is faced with the necessity of beginning instruction with an emphasis on speed, on accuracy, or on speed and accuracy simultaneously. Current practices in physical education tend to favor Poppelreuter's law of practice, which states, in essence, that best results in motor learning are found when speed is retarded until a reasonable level of accuracy has been obtained, and then is increased gradually. The hypothesis made in such instruction is that accuracy is attained better at a low rate of speed, and that the level of accuracy attained at low rates of speed is maintained when speed is increased.

Some studies have favored this point of view. Sturt (10), Hansen (6) and Myers (8) concluded that in such motor performances as typing, sorting cubes, and simple reaction to visual and auditory stimuli the most efficient learning is achieved by early emphasis on accuracy. On the other hand, experiments conducted by Fulton (4), have shown that speed attained under an emphasis on speed readily transfers to a period where both speed and accuracy are considered important, while an accuracy set does not develop under similar conditions to any sizable degree. She advocates early emphasis on speed on these grounds.

The Problem

This study was made to determine the relative effects of emphasizing speed, accuracy, or speed and accuracy equally, upon the learning and performance of a motor skill involving both speed and accuracy. Emphasis on one of these factors was given through verbal instructions to the subjects. The motor skill studied consisted of a movement in which the subject stepped forward over a distance equal to his height and struck a fixed target. The striking movement may be seen in Figure I.

Experimental Equipment

Equipment used in the experiment consisted of a photoelectric system, a $\frac{1}{100}$-second electric clock, a twelve-ring target, a scoreboard to indicate accuracy

[1] This study was made under the direction of Dr. Arthur T. Slater-Hammel in the Research Laboratories, School of Health, Physical Education and Recreation, Indiana University, Bloomington, Indiana.

scores, and a striking instrument. The latter instrument was designed to lessen the shock of contact with the target, and was held in the non-favored arm of the subject during the thrusting movement.

Immediately before beginning the movement, the subject assumed the position seen at the left of Figure I. The light beam passed between the arm in

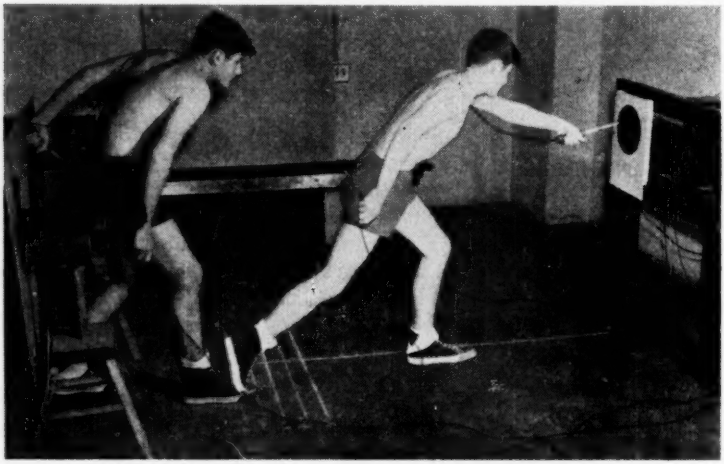

Fig. I. The Striking Movement Studied in the Experiment.

its back position and the lumbar region of the subject's back. When the subject stepped forward to strike the target the light beam was momentarily interrupted, causing the clock to start. When the striking instrument contacted the target, two things happened. First, the clock stopped. Second, the ring of the target contacted was indicated on the scoreboard which was placed in front of the tester. Each of the twelve rings of the target was insulated and wired separately to a particular light on the scoreboard, making it possible to determine the exact ring of the target first contacted by the striking instrument.

Speed was measured as the length of time elapsing between the beginning of the forward motion of the arm and the striking of the target, and was measured in hundredths of a second. Accuracy was determined by the ring of the target contacted first, the bullseye counting one point and each adjacent ring outward one additional point. In both measures, lower scores indicated better performances.

Procedures

Three groups of subjects, with approximately 39 in each group,[2] were selected by random sampling techniques. Subjects were selected so they could be

[2] Thirty-nine subjects were originally selected for each group. Due to excessive absences, illness, and so on, this number was reduced to 38 in the speed group, 35 in the accuracy group, and 36 in the equal emphasis group.

tested at the rate of nine per period. All subjects were given ample opportunity to become familiar with the equipment before the actual testing began. A criterion of three successive thrusts without mechanical error was used to determine the readiness of the subject for testing.

During the first half of the experiment one of the groups received initial emphasis on speed, another on accuracy, and another on speed and accuracy equally. This initial emphasis period lasted three weeks, with subjects taking 15 trials per day two days per week. A total of 90 thrusts were taken by each subject during the initial emphasis period.

All groups were told to give equal emphasis to speed and accuracy during the last half of the experiment. This equal emphasis period also lasted for three weeks, with the subjects following the same schedule as in the initial emphasis period.

During the experiment all subjects were reminded at frequent intervals to work toward improvement of the emphasized factor or factors. At no time was an unemphasized factor mentioned during the initial emphasis period. Each subject was told his mean score on the emphasized variable or variables on each subsequent day of testing.

The mean performance in speed and in accuracy of each subject and of each of the experimental groups were computed daily. Statistical techniques were then applied to determine the significance of differences in speed and in accuracy of the groups at the end of the initial emphasis period and each day of the equal emphasis period. The factors speed and accuracy were treated separately in order to facilitate interpretations.

Analysis of Data

Speed. The learning curves in speed of the three experimental groups may be seen in Figure II. In the initial emphasis period, the group which received initial emphasis on speed gained consistently, the group which received equal emphasis on speed and accuracy made steady progress but not as rapidly as the speed group, and the group which received initial stress on accuracy lost fairly consistently. At the end of the initial emphasis period, large differences were evident in the mean speed scores of the three groups.

In the last half of the experiement, with all groups receiving equal emphasis on speed and accuracy, the speed group tended to maintain the level of speed attained in the initial emphasis period, the equal emphasis group gained somewhat steadily, and the accuracy group gained sharply on the first day after switching emphasis, then continued to make steady progress throughout the remainder of the experiment. It seems highly probable that had the experiment been prolonged for a few more testing periods, all three groups would have attained approximately equal speeds.

A positive correlation existed between the mean speed scores and the standard deviations of these scores throughout the experiment. As the speed became more efficient, the variability decreased; as the speed became higher, the variability increased. Figure III illustrates this relationship.

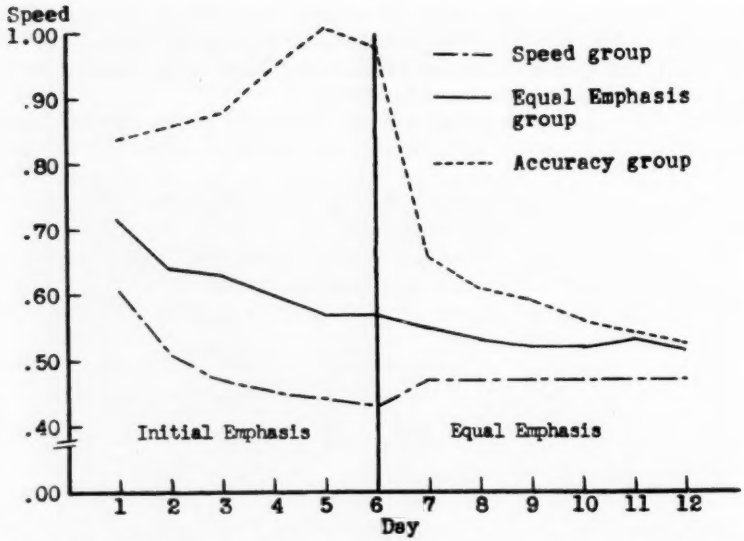

Fig. II. Mean Performance in Speed of the Three Experimental Groups. (*Speed indicates time required to complete the movement.*)

Analysis of variance was used to determine the statistical significance of the differences which existed in both the mean speed and mean accuracy scores of the three experimental groups at the end of the initial emphasis period and each testing day of the equal emphasis period. This technique was employed to test the hypothesis that all three experimental groups came from the same population in terms of the factor being tested, i.e., that obtained differences in this factor could be attributed to chance. In the event this hypothesis were rejected, the *t*-test was applied to ascertain the statistical significance of observed differences between individual groups.

At the end of the initial emphasis period, significant differences were found in the mean speed scores of all three experimental groups. An F of 162.98 was found, and, when compared with the value of 4.82 needed for significance at the one per cent level of confidence in samples with two degrees of freedom, it was evident the three groups were not from the same population in terms of speed. The *t*-test, applied to the differences between individual groups, further demonstrated the significance of the differences found in the speed of the three groups at this stage of the experiment.

A *t* of 19.79 was found for the difference between the speed and accuracy groups, of 4.97 between the speed and equal emphasis groups, and of 14.64 between the accuracy and equal emphasis groups. All of these *t*'s were significant at far beyond the one per cent level of confidence. Recognizing the limitations of these tests in groups which are not homogeneous in variability, it still seems highly probable that true differences in speed were developed in the three experimental groups as a result of the initial verbal emphasis.

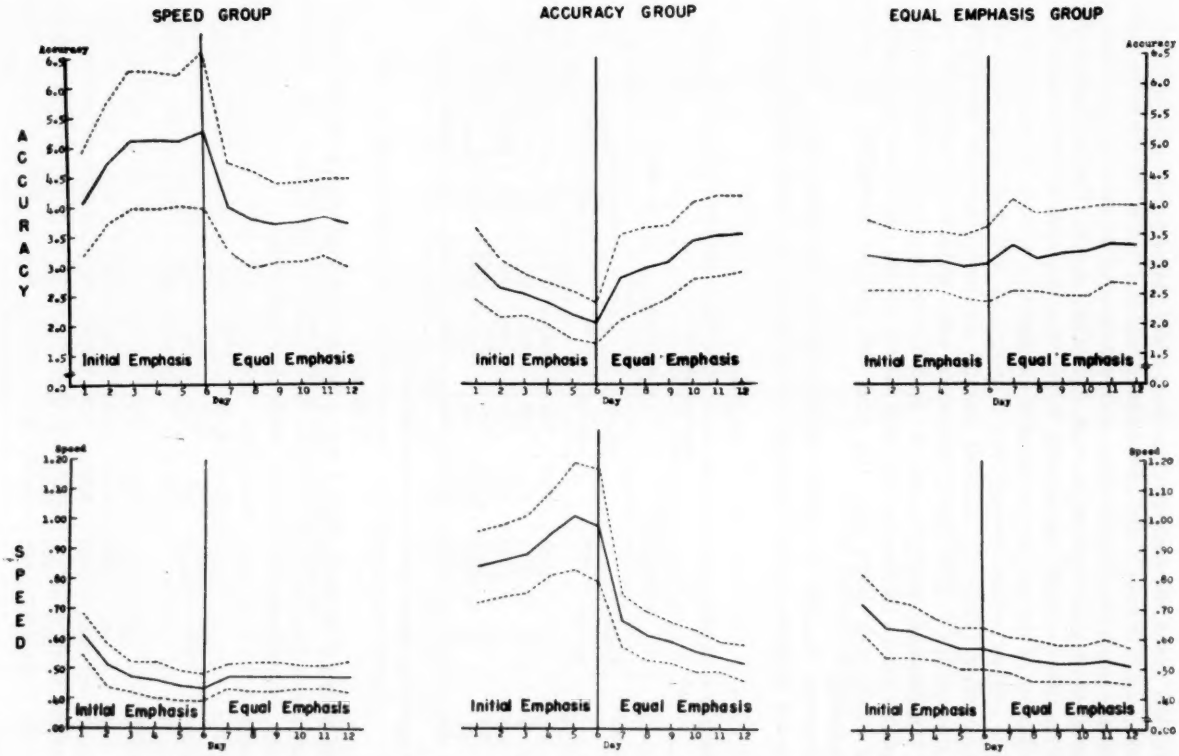

Fig. III. Profiles of the Means and Sigmas of the Daily Speed and Accuracy Scores of the Experimental Groups.

Table 1 shows the computations from which the analysis of variance was made on each of the six days of the equal emphasis period. As this table indicates, the hypothesis that all three groups were equal in speed save for chance differences could be rejected for each day of this period. The smallest of the obtained F's was 7.29, considerably larger than the value of 4.82 needed for significance at the one per cent level of confidence.

The *t*-values secured for each pair of groups for each day of the equal emphasis period (Table 2) indicated that all obtained differences between individual groups in speed during this period were significant at beyond the one per cent level of confidence with the exception of the accuracy and the equal emphasis groups on the eleventh and twelfth testing days. The speed group was significantly faster than the other two groups throughout the entire experiment.

Accuracy. During the initial emphasis period the group which received accuracy emphasis gained consistently in accuracy, the group which received

TABLE 1

Analysis of variance of the mean speed scores of the three experimental groups in the equal emphasis period

Day	Between Means			Within Groups			Total		F
	Degrees of Freedom	Sum of Squares	Variance	Degrees of Freedom	Sum of Squares	Variance	Degrees of Freedom	Sum of Squares	
7	2	.6949	.3475	106	.4613	.0044	108	1.1562	78.98*
8	2	.3344	.1672	106	.4585	.0043	108	0.7929	38.88*
9	2	.2523	.1262	106	.3724	.0035	108	0.6247	36.06*
10	2	.1548	.0774	106	.3596	.0034	108	0.5144	22.76*
11	2	.0866	.0433	106	.3253	.0031	108	0.4119	13.97*
12	2	.0510	.0255	106	.3242	.0035	108	0.3752	7.29*

* Significant at beyond the one per cent level of confidence.

TABLE 2

Standard error of the means, standard error of the differences, and t-values of the speed scores of the experimental groups in the equal emphasis period

Day	(Standard Error of Mean)*			Standard Error of Difference			t		
	Speed Group	Accuracy Group	Equal Emphasis Group	Speed-Accuracy Groups	Speed-Equal Emphasis Groups	Accuracy-Equal Emphasis Groups	Speed-Accuracy Groups	Speed-Equal Emphasis Groups	Accuracy-Equal Emphasis Groups
7	.0001	.0001	.0001	.0155	.0154	.0157	12.5613	5.1888	7.3121
8	.0001	.0001	.0001	.0153	.0152	.0155	8.8366	3.7697	5.0258
9	.0001	.0001	.0001	.0139	.0137	.0140	8.4604	3.8248	4.6571
10	.0001	.0001	.0001	.0136	.0135	.0138	6.7574	3.7630	2.9783
11	.0001	.0001	.0001	.0130	.0129	.0132	4.8308	4.2558	0.5985*
12	.0001	.0001	.0001	.0139	.0137	.0140	3.5827	2.8978	0.7214*

* Non-significant.

equal emphasis of speed and accuracy maintained their accuracy, approximately, and the group which received initial emphasis of speed lost sharply in accuracy for three testing periods, then less sharply for the final three testing periods under initial emphasis. Differences in mean accuracy of the three groups at the end of the initial emphasis period were large. Figure IV shows the learning curves of the three groups in accuracy.

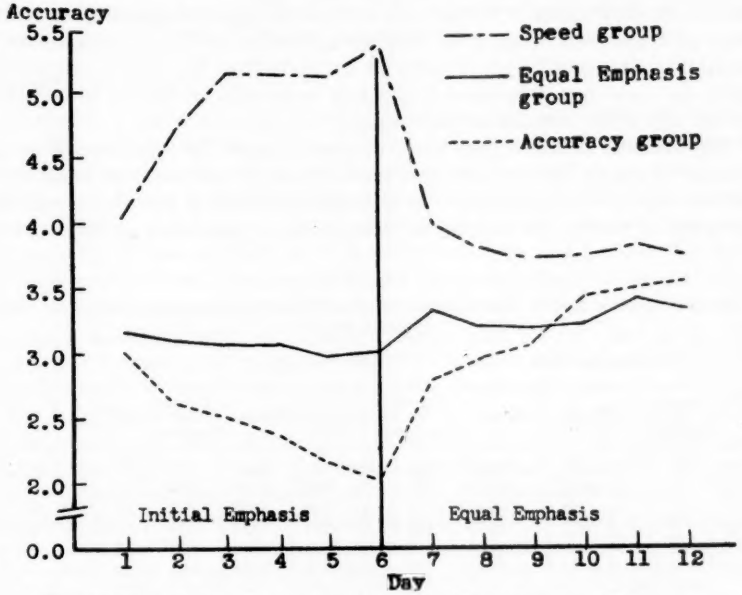

Fig. IV. Mean Performance in Accuracy of the Three Experimental Groups.

In the equal emphasis period, the accuracy group lost all of the accuracy gained in the initial emphasis period within two testing periods after changing emphasis. The speed group gained sharply in accuracy on the first day after changing emphasis, and then generally maintained that level of accuracy throughout the remainder of the experiment. The equal emphasis group unaccountably lost somewhat in accuracy on the first day after changing emphasis, then approximately maintained that level of accuracy for the rest of the testing. Again the three groups showed a tendency to approach somewhat equal levels of accuracy in the latter stages of the experiment.

The variability of the accuracy scores was positively related, like that of the speed scores, to the mean scores of the experimental groups. The lower the mean accuracy became, the lower the variability was. As the accuracy scores increased, the variability also increased.

Applying the analysis of variance technique to the accuracy scores of the three groups at the end of the initial emphasis period, an F of 130.50 was found.

Since this value was much larger than the one of 4.82 needed for significance at the one per cent level of confidence, true differences existed in the accuracy scores of the three groups at this time.

All *t*-tests between the accuracy scores of the individual groups at this point in the experiment yielded significant values, that of the speed and accuracy groups being 15.67, of the speed and equal emphasis groups being 10.99, and of the accuracy and equal emphasis groups being 4.70. A value of 2.63 was needed for significance at the one per cent level. Again recognizing the limitations of these tests when used with groups which are not homogeneous in variability, it seems highly feasible to conclude that the verbal instructions given did cause true differences in accuracy to develop among the three groups by the end of the initial emphasis period.

The F-values obtained from the accuracy scores of the experimental groups on each of the six days of the equal emphasis period are shown in Table 3. All of these F's were significant at the one per cent level of confidence with the exception of that of the last day of the experiment, which was significant at the

TABLE 3

Analysis of variance of the mean accuracy scores of the three experimental groups in the equal emphasis period

Day	Between Means			Within Groups			Total		F
	Degrees of Freedom	Sum of Squares	Variance	Degrees of Freedom	Sum of Squares	Variance	Degrees of Freedom	Sum of Squares	
7	2	27.5327	13.7664	106	60.2800	.5687	108	87.8127	24.21*
8	2	13.6567	6.8184	106	58.7330	.5541	108	72.3897	12.32*
9	2	9.4386	4.7193	106	48.7889	.4603	108	58.2275	10.25*
10	2	5.2263	2.6132	106	51.3553	.5338	108	56.5816	4.89*
11	2	4.5385	2.2693	106	47.8326	.4513	108	52.3711	5.03*
12	2	3.1154	1.5577	106	52.3072	.4935	108	55.4226	3.16†

* Significant at beyond the one per cent level of confidence.
† Significant at beyond the five per cent level of confidence.

TABLE 4

Standard error of the means, standard error of the differences, and t-values of the accuracy scores of the experimental groups in the equal emphasis period

Day	(Standard Error of Mean)²			Standard Error of Difference			t		
	Speed Group	Accuracy Group	Equal Emphasis Group	Speed-Accuracy Groups	Speed-Equal Emphasis Groups	Accuracy-Equal Emphasis Groups	Speed-Accuracy Groups	Speed-Equal Emphasis Groups	Accuracy Equal Emphasis Groups
7	.0150	.0162	.0158	.1766	.1754	.1790	6.9350	3.8677	3.0525
8	.0146	.0158	.0154	.1744	.1731	.1767	4.7924	3.4500	1.3503*
9	.0121	.0132	.0128	.1589	.1578	.1610	4.2542	3.4157	0.8509*
10	.0140	.0153	.0148	.1712	.1697	.1735	1.8943*	3.0996	1.1625*
11	.0119	.0129	.0125	.1574	.1562	.1595	2.1315	3.0858	0.9185*
12	.0130	.0141	.0137	.1646	.1633	.1667	1.1476*	2.5126	1.3281*

* Non-significant.

five per cent level. The hypothesis that the three groups were from the same population in terms of accuracy on each day of the equal emphasis period was rejected.

Further analysis of the differences between individual groups (t-values may be seen in Table 4) showed no significant difference in accuracy between the accuracy and equal emphasis groups from the eighth day to the end of the experiment, while the accuracy and speed groups were not significantly different on the tenth and twelfth days of the experiment. All other differences were significant at beyond the one per cent level.

Summary and Conclusions

Emphasis on speed, accuracy, or speed and accuracy simultaneously, caused large differences to develop in mean speed and accuracy of three groups of subjects, approximately 39 per group, equalized by random sampling. All three groups showed significant differences in both of these factors at the end of the initial emphasis period. In accuracy, the group which received accuracy emphasis reached the highest level of performance in this period, the equal emphasis group the next highest level, and the speed group the lowest level. The speed group reached the best level of speed in this initial emphasis period, the equal emphasis group the next best speed, and the accuracy group the least desirable speed. At the end of the initial emphasis period the three groups were drawing further and further apart in both speed and accuracy.

The speed group was significantly faster than the other two groups throughout the experiment, while at the end of the experiment it was less accurate than the equal emphasis group and as accurate as the accuracy group. The accuracy and equal emphasis groups showed no statistical difference in accuracy after the eighth day of the experiment, while they remained different in speed until the eleventh day. The equal emphasis group was more accurate than the speed group, as accurate as the accuracy group, as fast as the accuracy group, and slower than the speed group at the end of the experiment.

There was evidence of a strong transfer of a speed set developed in the initial emphasis period into the equal emphasis period. This set, or habit, persisted throughout the last half of the experiment. If an accuracy set developed at all, it was lost shortly after the change in emphasis. There seems to be little evidence to support the contention that levels of accuracy gained at low rates of speed are maintained when the rate of speed is increased.

From all indications, the three experimental groups were approaching equal levels of speed and accuracy at the end of the experiment. It seems logical to conclude that the three groups were in the process of adjusting their speed to a comparable level of accuracy. The assumption in this reasoning is that speed is more easily controlled in a movement such as the one studied than is accuracy.

The following conclusions were drawn from this study:

1. Initial emphasis on speed, accuracy, or speed and accuracy equally, had a pronounced effect on learning measured in terms of achievement in speed and accuracy.

2. Speed developed under initial emphasis of speed readily transferred into performance where both speed and accuracy were considered important, and the transfer was very persistent.

3. Accuracy gained at low rates of speed was lost almost immediately when the rate of performance was increased.

4. Evidence from this investigation and other recent studies of a similar nature favors these replacements for Poppelreuter's law of practice:

(a) In skills in which speed is the predominate factor for successful performance, the most efficient results are attained by early emphasis of speed.

(b) In skills in which both speed and accuracy are important to successful performance, emphasis on both speed and accuracy yields the most desirable results.

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Continued from the March Quarterly

Research Abstracts

Prepared by the Research Abstracts Committee of the National Council of the Research Section, Carolyn W. Bookwalter, Chairman

Anatomy, Anthropology, and Physiology

15. AMPRINO, RODOLFO. Developmental correlations between the eye and associated structures. *J. Exp. Zool.*, **118:** 1 (Oct. 1951).

The correlations which arise during development between the eye and some periocular organs (lids, lacrimal glands, nasolacrimal duct) have been experimentally investigated. Partial or total ablation of the eye-forming material alone or associated with that of the neighboring ectoderm and mesenchyme of the head were performed in different stages of the somitic period (from 2 to 36 somites). No indication was found of an inductive activity exerted by the eye material on the determination and development of the periocular organs. Diminutive lids and glands developed in the total absence of the eyeball. The differentiation of the single tissue components was almost normal. Diminutive periocular organs developed when the eye material was removed (at stages between 8 and 14 somites) along with surrounding ectoderm and mesenchyme. It was assumed that in these cases lids and lacrimal glands formed at the expense of material regenerated from nearby ectoderm and head mesenchyme.

The eyeball is a mechanical factor in the organogenesis of its associated structures.—*The Wistar Institute.*

16. BARRY, ALEXANDER, The aortic arch derivatives of the human adult. *Anat. Rec.*, **111:** 2, (Oct. 1951).

One of the traditional phases of embryological teaching involves the fate of the embryonic aortic arches. The conventional diagrams, based on those of Rathke, indicate fairly adequately the general way in which the retention or regression of the various components of the embryonic aortic arch system result in the establishing of the normal and most of the abnormal patterns of the arterial stems arising from the heart. However, there is a considerable hiatus between these schematic diagrams and the definitive configuration of the arch of the aorta and its main branches in the human adult. During the development there are radical shifts in relationship due to the cauda; migration of the heart itself and to the concomitant differential growth of its associated vessels, making the adult configuration somewhat difficult to analyze satisfactorily in terms of its original embryological components. This communication presents a series of diagrams showing the positions of the segmental components of the embryonic aortic arch system as they have come to lie in the adult. A few typical abnormal configurations are presented in comparison with the normal. It is hoped that these diagrams, keyed as they are to segmental levels, will aid in describing anomalies of the arch of the aorta and its main branches in terms of their probable developmental origin.—*The Wistar Institute.*

17. BILLIG, HARVEY E., JR., M.D., Fascial stretching. *The J. of the Assoc. for Phys. and Ment. Rehab.*, Vol. 5, **2:** 4–8.

Physical Fitness is a broad term and when function is impaired it is necessary to break the term down into its various components in order to ascertain which ones are at fault. Mobility, for which most bodily structures are admirably designed, is limited if the fibrous tissue binds the body together too tightly. In addition to the contractures which result from disease, many other factors may "stiffen us." The continued assumption of positions characteristic of certain occupations is frequently a contributing factor. Response to the strain of an injury may also cause the fascial ligamentous bands to contract. Fascial ligamentous contractures may be generalized or in a specific region between the occiput and the lateral condyle of the tibia. A few of the signs and symptoms of fascial ligamentous contractures

include spastic hammer toes, "sciatica," Morton's Toe, metatarsalgia, low back pain and cervical neck pains. Relief from these complaints may be obtained by releasing the nerves from their constricting irritation in the foramina by loosening the contracted fascial ligamentous ramifications. To accomplish this purpose progressive stretching exercises are advised. Passive and active exercises for the affected parts of the spine, in order to achieve full mobilization, must be carried out correctly, vigorously and routinely for days or months as the case demands.—*F. D. Sills.*

18. CACCESE, ANTHONY AND SCHRAGER, ALVIN. The effects of cigarette smoking on the ballistocardiogram. *American Heart Journal*, **42:** 589–597 (Oct. 1951).

A group of 31 subjects were tested, of these 23 were normal, healthy persons with no evidence of vascular or other disease, 3 had coronary heart disease, 1 anterio-sclerioscleroticperipheral vascular disease, 3 with Buerger's disease, and one with rheumatic heart disease and pleural effusion. All subjects refrained from smoking for a period of not less than two hours before the test. Simultaneous electrocardiogram (one lead), capillary finger pulse, and electromagnetic ballistocardiogram were recorded. Control tracings were taken during normal breathing, held inspiration, held expiration, and following a few minutes of deep breathing. With the subject in the same position, he was given a standard brand cigarette to smoke. No records were taken 20 minutes after the cigarette was finished. Of the 31 tested 18 showed changes in ballistocardiogram as a result of smoking one standard cigarette. Seven had severe changes which consisted of an increase in respiratory variation and distortion of curve pattern. These were transient, disappearing in one to twenty minutes. Deep breathing affects the ballistocardiogram, but in no way approaches the effect of smoking.—*J. Grove Wolf.*

19. GREENBERG, B. G., AND BRYAN, A. H., Methodology in the study of physical measurements of school children. *Human Biology*, **23** (2): 160–179, (May 1951).

The technique of co-variance was employed in the analysis of anthropometric characteristics of school children. The results indicated that children 8 through 11 years of age from upper socio-economic classes were taller and weighed more for their age. They were not heavier for their age when consideration was made for the fact that they were taller. The boys appeared to have more muscle mass and subcutaneous fat, as judged by calf circumference, for their age and height. The difference was not sufficiently great to cause significant weight changes. Girls, ages 6 through 8 years, in upper socio-economic group, appeared to have more muscle mass and subcutaneous fat of an amount sufficiently great to cause weight differences for their age and height over those in a different socio-economic class. The chest measurement, as a physical discriminant between socio-economic groups. offers little additional information which was not already provided by weight, height, and possibly calf-circumference.—*D. B. Van Dalen.*

20. CREGO, CLARENCE H., JR., M.D. AND FORD, LEE T., M.D. An end-result study of various operative procedures for correcting flat feet in children. *The J. of Bone and Joint-Surgery*, **34-A,** 1;183–195.

Two main types of flat feet are encountered in children: flaccid flat feet (weak feet) in which a longitudinal arch is present without weight bearing but collapses when weight is supported by the feet; and the spastic flat foot or foot held in spastic eversion. Flaccid flat feet in children are found frequently and are generally asymptomatic. Surgery should rarely be considered in these cases. The records of 53 children on whom operations had been performed for the relief of painful flat feet were reviewed. A total of 111 surgical procedures were performed. It was concluded that (1) in no case should an arthrodesing operation be done for cosmetic reasons only, (2) the patient (and others concerned) must be willing to exchange a loss of inversion and eversion for the relief of pain and disability, and (3) that arthrodesing operations should include the subtalar joint as well as the talonavicular and the naviculo-cunieform joints.—*F. D. Sills.*

21. GOFF, CHARLES WEER, M.D., Orthograms of posture, *J. Bone and Joint Surg.*, Vol. **34-A,** 115–122.

Thirty-four hundred photographs were body typed using Sheldon's method as modified by Hooton (linear, muscular, and fat types). A fourth type called the muscular-balanced (average-man) type was introduced into the study. A standard ten-inch image was established by using a stereoptican. This method made it possible to trace the lateral photographs on thin paper, and by superimposing the tracings it was possible to arrive at a mean for the linear type, the fat type, the muscular type, and the muscular-balanced type. These mean types were the orthograms for each body build and proved to be characteristic of the particular constitutional type which they represented.

A line was dropped perpendicular to the horizontal plane from the cranial vertex on each of the four orthograms. This line represented the gravitational pull for the whole body. Lines were also drawn from the vertex to the anterior edge of the sacrum, from the sacrum to the middle of the patella and from the patella to the head of the talus. The areas defined by these lines were then blacked in on each of the four types. These polygrams indicated that marked differences existed between the four mean body types. Only the muscular body type was found to be representative of what has commonly been considered "ideal posture" stance. The other types cannot normally assume such a stance and should not be expected to do so. This study establishes a scientifically sound basis for determining the normal posture of young, adult, white males standing at ease.—*F. D. Sills.*

22. GOFF, CHARLES WEER. Mean posture patterns with new postural values. *Am. Jr. Phys. Anthrop.*, **9:** 3 (Sept. 1951).

New basic posture patterns are presented. These types are distinct and are objectively arrived at by comparative studies of body build photographs of 40,000 white male, veteran separatees from the Army. A total of 3,400 were selected for range of distribution of 98 body types. Three polar types—the fat type, the muscular type and the thin, elongated type—were collected in their respective groups, together with a fourth showing a balanced value of the first two components.

Each type of body build was found to possess a characteristic posture pattern. Fat types, 11 per cent of the sample, have a medium lumbar curve and a mild dorsal curve. Muscular types, 11 per cent of the sample, show a mean lumbar curve greatest of any type in the study. This type seems to stand more erect and comes nearest to the aesthetically conditioned standard of "good posture." Thin, elongated body builds, (18 per cent of the population sample) portrayed a long lumbar curve, gradual and moderate with an equally long but quite marked dorsal curve, approaching a kyphosis or stoop. The balanced type (26 per cent of population sample) is midway between the muscular and the fat types, showing a milder lumbar curve, together with a medium dorsal convexity. This type is probably better adjusted to the requirements of military as well as every day life. It was the modal of the series. These profile photographic tracings correlated well with lateral roentgenographic studies of the spine.—*The Wistar Institute.*

23. KRAMER, IVOR ROBERT HORTON. A technique for the injection of blood vessels in the dental pulp using extracted teeth. *Anat. Rec.*, **111:** 1 (Sept. 1951).

The dental pulp is richly vascular tissue and a clear concept of the distribution of blood vessels is most easily obtained from a study of injected material. However, the technical difficulties of preparing such specimens are great unless the injection mass is introduced into the carotid artery or similar large vessel. Consequently, most studies have been made on animal material.

The technique is described which permits the injection of the blood vessels in extracted teeth and which is, therefore, suitable for the study of human material. The method depends

on the production of a minute exposure of the coronal pulp. To this exposure, gentle suction is applied and as the contents of the vessels are aspirated through the damaged capillary loops in the exposed area, India ink is allowed to enter the vessels at the apical foramen. Injected specimens may be sectioned or cleared in methyl salicylate after preliminary trimming.—*The Wistar Institute.*

24. NEWCOMBER, E. O., AND MEREDITH, H. V., Eleven measures of body size on a 1950 sample of 15-year-old white schoolboys at Eugene, Ore. *Human Biology*, **23** (1): 24–40. (Feb. 1951).

Eleven measures of body size on a random sample of 102 white boys from Eugene, Ore., ranging in age from 14 years 9 months to 15 years 3 months were taken. The anthropometric reliabilities ranged from .981 to .999. Reliabilities were lowest for shoulder width (.981), abdomen girth (.986), and chest girth (.985). The authors quantitatively describe the body size of the boys studied and compared this group with other groups of boys of like age described in the physical growth literature. In no instance were the Eugene schoolboys surpassed by the schoolboys of other North American studies in the means for stature, weight, stem length, shoulder width, hip width, chest girth, upper limb length, lower limb length, arm girth, and leg girth measurements.—*D. B. Van Dalen.*

25. PEASE, DANIEL CHAPIN. Electron microscopy of human skin. *Am. J. Anat.*, **89**: 3 (Nov. 1951).

Ultrathin sections of human skin have been studied with the electron microscope. Delicate cell membranes were found between prickle cells, bisecting the spaces between the cells. The spaces therefore proved to be intracellular, although there is reason to believe them to be largely by-products of fixation. The knots of Ranvier within the cell bridges are derived from pigment granules which migrate into positions where cell membranes are forming. Presumably the granules become decolorized. Transitional stages of pigment formation probably have been seen in some "clear" cells. Tonofibrils are regarded mainly as fixation artefacts, although they may indicate gelated structures in life. Special efforts have been made to resolve the epidermo-dermal junction. A cell membrane exists here, and an amorphous cement substance seems to attach this by blending with collagenous fibers. The characteristically banded structure of collagen rarely shows in osmium fixed sections. It is thought that this is obscured by amorphous material, probably the mucopolysaccharides of "ground substance."—*The Wistar Institute.*

26. TANNER, F. M., Some notes on the reporting of growth data. *Human Biology*, **23** (2): 93–160. (May 1951).

This study discusses the biometrical handling of growth data, particularly those from a mixed longitudinal series, i.e., a series of children some, but not all, of whom leave the study each year, and some of whom, of various ages arrive newly each year. Part I of the study deals with the single measurement, re-emphasizing the importance of reporting longitudinal data and discusses the technique needed to get the maximum information out of the data from mixed longitudinal series, and from a long series of measurements on a single individual. Part II deals with the simultaneous reporting of two or more measurements.—*D. B. Van Dalen.*

27. THOMPSON, HELEN, Data on the growth of children during the first year after birth. *Human Biology*, **23** (2): 75–93. (May 1951).

The data in this study were collected in connection with the Yale University Clinic of Child Development Normative Study of Infancy. Measurements of nine dimensions—vertex height, suprasternal height, symphysis height, biacromial diameter, chest breadth, chest circumference, bicristal diameter, head circumference, and weight—were made every four weeks on 32 male and 36 female healthy infants from 6 weeks to 52 weeks old. A few of the actual raw data were extended up to 10 years of age.—*D. B. Van Dalen.*

Education

28. MAASKE, ROBEN J. Analysis of trends in teacher supply and demand, 1900–1950. *The Journal of Teacher Education*, **2:** 4,263–268 (Dec. 1951).

From an analysis of the literature, the author discovered that teacher supply and demand is unique to the 20th century. It appears that the teacher-supply-and-demand situation is more dependent upon the general state of economic prosperity outside the teaching profession than upon any one other single factor.

The peaks of oversupply of teachers occur chronologically in 1901, 1903, 1915, 1928, 1933, 1940, and 1949 (high school only). In comparison, the depression-point years in the business cycles indicating below average prosperity occur in 1900, 1904, 1908, 1912, 1914, 1919, 1921, 1924, 1927, 1933, 1938, and 1949.—*Carolyn Bookwalter.*

29. WOOD, HUGH B. In-service education of teachers—an evaluation. *Journal of Teacher Education*, **2:** 4: 243–247 (Dec. 1951).

Early in 1951, one-third of the teachers and administrators in Oregon were sampled in the appraisal of the values of certain phases of a state in-service program for teachers. Major techniques and activities were covered in a 38-item questionnaire.

Four-fifths of the teachers feel competent in the command of subject-matter and general methods. They feel less secure in the use of newer material and with working with pupils and parents. College courses and work conferences were generally rated high in the value of improving teaching competency. The average Oregon teacher devotes the equivalent of 106 eight-hour days each year to activities designed to promote his or her professional growth (this is based on a 365-day year and includes time outside the normal classroom day of seven or eight hours). Administrators believe much more strongly than do elementary or secondary school teachers in the potential and actual value of in-service training activities. They devote more time to in-service activities for themselves than do teachers. Single teachers devote one-third again as much time to in-service activities as do the married teachers.—*Carolyn W. Bookwalter.*

Health and Safety

30. O'CONNOR, BASIL. The growing polio problem. *Today's Health.* **30:** 28–29 (Jan. 1952).

Polio is the one uncontrollable epidemic disease that is on the increase today. In the last four years, 1948 through 1951, there have been more cases of polio in the United States (132,000) than in the previous ten years combined. The National Foundation for Infantile Paralysis through the March of Dimes has taken steps to meet this problem. The number of hospitals equipped to care for polio patients has increased from about 300 hospitals in 1938 to over 900 at the present time. Since 1938, over $120,000,000 has been spent by the National Foundation for Infantile Paralysis and the figures continue to mount yearly due to increasing numbers of polio cases and rising costs. Blood sampling surveys indicate about 85% of the population have been exposed to the polio virus by the time they reach 15 years of age and have developed some resistance to the disease. Scientists at Children's Medical Center in Boston have successfully grown polio virus in test tubes and have recently discovered that the virus grown in tubes loses some of its infectivity for its original host. This strengthens the hope that it may be possible to develop a strain that will no longer be infective for man and can be used to protect him against this dreaded disease.—*J. Grove Wolf.*

31. FRANKEL, GEORGE W., M.D. Sorry—I didn't hear you. *Today's Health*, **30:** 38–41 (Feb. 1952).

Four million people in this country suffer from borderline impairment of hearing. People with hearing impairment soon become maladjusted in their social, economic, and personal life. Treatment to alleviate and possibly cure this condition may be medical, surgical, or mechanical. Dr. Julius Lempert of New York is primarily responsible for the development of the fenestration operation. The surgeon creates a small window through which sound waves reach the inner ear and the nerve of hearing. The surgical risk is negligible and chances for retaining gains in hearing are excellent. The modern hearing aid has also done much to make life more enjoyable for those suffering from impaired hearing.—*J. Grove Wolf.*

32. JOHNSTON, FRANCES ANN AND DORETTA SCHLAPHOFF. Nitrogen retained by six adolescent girls from two levels of intake. *J. Nutrition*, **45:** 4, (Dec. 1951).

Six girls between 13 and 14 years of age lived on a controlled diet for 9 weeks. The first two weeks comprised a preliminary period. During the first experimental period of three weeks the mean daily intake of nitrogen was 12.20 gm. corresponding to 76.2 gm. of protein. The mean daily amount of nitrogen retained from the diet by the six subjects was 1.42 gm. or 0.97 gm. per m^2 or, 29.9 mg. per kilogram. During the second experimental period of 4 weeks the mean daily intake was raised to 13.97 gm. corresponding to 87.3 gm. of protein. On this diet the mean daily amount of nitrogen retained was 2.17 gm. or 1.45 gm. per m^2, or 43.7 mg. per kilogram. The mean intake of 76.2 gm. of protein per day was probably adequate for these subjects. The intake of 87.3 gm. of protein was undoubtedly more than adequate.

During the first period on a mean intake of 2,710 cal. a day four of the subjects maintained weight and two gained at an average rate. During the second period all the subjects gained weight at a faster than average rate on a mean intake of 2,880 cal.—*The Wistar Institute*

33. KRAFT, ROSE ALLEN AND AGNES FAY MORGAN. The effect of heat treatment on nutritive value of milk proteins. IV. The biological value of unheated and autoclaved dried skim milk. *J. Nutrition*, **45:** 4 (Dec. 1951).

Three samples of dried milk supposedly processed at different temperatures were found to have similar solubilities and identical protein efficiencies for the growth of young dogs. After 56 days two of the dogs were fed a diet containing milk autoclaved 15 minutes at 118°C., but again no striking changes in growth appetite, nitrogen retention or serum protein resulted. Two of the unheated milk samples and one autoclaved for 15 or 25 minutes at 120°C. were then fed at a 12% protein level to groups of rats alone and supplemented by lysine, methuinine, valine of all of these amino acids, all at the 1% level. The milk autoclaved for 15 minutes lost from one-half to two-thirds of its growth efficiency but this was largely restored by the lysine or lysine, methionine, and valine supplement. The sample autoclaved for 25 minutes did not support growth except when lysine-supplemented. The efficiency of these diets for liver, kidney and serum protein production differed significantly but lysine supplementation restored the value of the autoclaved milk to normal in these respects.—*The Wistar Institute.*

34. LEICHSENRING, JANE MARIE, LOANA MIRIAM MILLER NORRIS, AND SARA ANN PFREMMER LAMISON. Magnesium metabolism in college women: Observations on the effect of calcium and phosphorus intake levels. *J. Nutrition*, **45:** 4, (Dec. 1951).

Nine healthy college women served as subjects for a magnesium metabolism study. During the first four weeks all subjects were maintained on a basal diet which supplied approximately 260 mg. magnesium, 300 mg. calcium, and 800 mg. phosphorus. This was followed by a second 4-week period during which three of the subjects were continued on the basal diet, three were given a supplement of 1,200 mg. calcium, and the remaining three supplements of 1,200 mg. calcium and 600 mg. phosphorus. During weeks 2, 3, and 4, the mean daily fecal excretion of magnesium was 153.5 mg. with a standard error of 3.8 mg., the urinary excretion was 96.2 mg. with a standard error of 3.2 mg., and the retention was 11.6 mg. with a standard error of 2.9 mg. Statistically significant differences between subjects were observed in each instance. Using partial correlation as criteria, a significant relationship was observed between fecal calcium and phosphorus, but not between magnesium and either of these elements. When the same statistical technique was applied to the retention data, there was no evidence of association between calcium and magnesium or between phosphorus and magnesium, although a highly significant association between calcium and phosphorus was observed. Urinary excretion of magnesium was significantly correlated with the intake levels of both calcium and phosphorus.—*The Wistar Institute.*

35. MCBRIDE, BYRON HENRY, BARBARA TAIT GUTHNECK, EUGENIA HOFFERT, DOROTHY MARIE KNICKEL, AND BERNARD SYLVESTER SCHWEIGERT. Effect of frying bacon on the nutritive value of the protein. *J. Nutrition*, **45:** 3 (Nov. 1951).

The effect on the nutritive value of the protein attributable to cooking was investigated. Lyophilized and ether-extracted bacon was fed as the sole source of protein at a 10% level in the diet to weaning rats. No reduction in the utilization of the protein by weanling rats was observed in three tests with crisp-fried (well-done) bacon or in one test with limp-fried (medium-done) bacon, as compared to control groups receiving uncooked bacon. A small reduction in the nutritive value of the protein, which was statistically significant, was observed for one test with crisp-fried bacon. The per cent weight losses of the bacon during cooking and the proximate analyses of the cooked and uncooked products are presented.—*The Wistar Institute.*

36. Szymanski, Betty Beall and Bernard B. Longwell. Plasma vitamin A and carotene determination in a group of normal children. *J. Nutrition*, **45:** 3 (Nov. 1951).

Plasma vitamin A and carotene determinations have been made on a series of 95 normal children, ranging in age from 2 to 16 years, at regular intervals over a period of three years. Both vitamin A and carotene levels in the plasma vary with age, showing the highest values near one year of age. In these children, plasma vitamin A was slightly correlated with amount of supplementation of the diet with vitamin A concentrate, but not with the level of vitamin A from the plant sources. There was a sex difference in both plasma vitamin A and carotene in the infants studied, the girls showing significantly higher values. Just before adolescence, their carotene levels also drop. There was a seasonal variation in plasma carotene. The values found from June through November were significantly higher than those found in the same children from December through May.—*The Wistar Institute.*

Nutrition

37. Doyle, Margaret Davis and Thelma E. Porter. The effect of kind and level of protein in the diet on the production of soft and skeletal tissues. *J. Nutrition*, **45:** 1 (Sept. 1951).

The effect of variations in the kind and amount of protein intake upon the calcium utilization of growing albino rats was studied. Whole milk, whole wheat casein, and gluten, fed singly or in certain combinations, were the sources of protein. Protein was supplied at levels of approximately 8 and 27 per cent. In one of the three experimental periods, the amount of calcium in the diet was reduced to approximately one-fourth of the amount given in the other periods. Both ad libitum and restricted feeding methods were employed.

The final weights of the animals varied considerably, depending on the quantity or quality of protein consumed. Animals receiving low-calcium diets had lighter femurs containing a smaller percentage of calcium and of ash than did the others. A study of the animals on restricted feeding indicates that on low levels of calcium intake, casein tends to favor bone formation to a greater extent than does gluten. This may be considered a direct effect of protein on bone formation. Protein may also exert an indirect effect on bone formation by promotion of a growth of soft tissue which is out of proportion to the amount of skeletal tissue. Such an indirect effect of protein was observed in this study when relatively high levels of wheat or gluten, or both, were fed.—*The Wistar Institute.*

38. Macy, Icie Gertrude and Helen Alvina Hunscher. Calories—a limiting factor in the growth of children. *J. Nutrition*, **45:** 2 (Oct. 1951).

Values illustrating pertinent aspects of the relation of calorie intake to growth were selected from the published data of a comprehensive study of nutrition and chemical growth in childhood. The values demonstrated: (1) wide variation in the growth process of the same child at different times and of different children at the same time; (2) that appetite may not be relied upon to assure ingestion of quantities of a good mixed diet which will provide sufficient calories for satisfactory weight gains; (3) that existing "standards" may not be depended upon in every instance as criteria of dietary adequacy; (4) a depression of nitrogen retention when intake of calories is insufficient to permit proper gain in body weight; (5) that invisible growth may occur, as evidenced by nitrogen retention, coincident with failure to accomplish satisfactory gains—or even with a loss—of body weight; (6) that a difference in intake of as few as 10 cal. per kilogram of body weight may spell success or failure in making satisfactory progress in visible and invisible growth.—*The Wistar Institute.*

39. RASH, J. KEOGH. An evaluation of the duties of health educators. *The Journal of School Health*, **21:** 7 (September, 1951).

The investigator personally interviewed 75 selected health educators representing secondary schools, colleges, official agencies, and health co-ordinators, and identified their duties. The ten areas into which these duties were classified are: general education, health education, health service, supervision, public relations, counseling, organization, administration, community activities, and self-improvement. Some duties were common to the various health educators, but the pattern mainly tended to divide the educators into one of two groupings, school and college health educators and public health educators. These duties were then evaluated as to importance and difficulty, and it was discovered that School Health Educators ranked community service, health service, and organization duties very low in importance. It is evident that a basic consideration of the importance and difficulty of duties is essential in planning the curricula for health educators.—*Edward J. Gilday.*

Physical Education

40. ROBINSON, FRANK. A comparison of starting times. *Athletic Journal*, **32:** 24, 81–84 (Sept. 1951).

This study is a comparison between stance, starting, speed, and direction of the traditional three-point stance, two-point stance (with feet even), and the unorthodox two-point stance (with feet staggered) in football backfield play. Each stance was measured in the following directions: straight ahead, 90 degrees to the right and to the left, and 45 degrees to the right and to the left. Every subject was tested three times in each of five directions but on only one stance each day. Eighteen subjects completed the test for all three stances, and 10 others completed the test for two of the stances. An electric timing device was used to measure the elapsed time from an oral starting signal until the subject reached a beam of light operating the electric eye 10 feet away. No significant differences in starting times were found between the stances when starting 90 degrees to the right, 45 degrees to the right, and 45 degrees to the left. The two point stance proved to be significantly faster when starting 90 degrees to the left. The staggered two-point stance proved to be significantly faster when starting straight ahead. There was much inaccuracy between the subject's feelings regarding whether the start was fast or slow and the actual recorded time.—*J. Grove Wolf.*

41. SWARTOUT, J. M. Scholastic boxing—is it justified? *Today's Health*, **29:** 18–19, 62–65 (Oct. 1951).

Recently a survey was reported in the *Research Quarterly* entitled, "The Evaluation of Boxing as a College Activity." Eighty-four colleges reported to the questionnaire, 12 had noted cases of punch drunk in their boxing students, and 4 had noted cases of amnesia. More than 50% of the athletic directors announced they were not in favor of intercollegiate boxing and 41% of the health service directors who responded felt that boxing was not a healthful activity for college students. Fifty-eight percent did not think boxing was an appropriate sport for high school boys. In 1948, only 11 states even implied in their statutes that interschool boxing was prohibited, and 32 made boxing legal in public schools. Such authorities as Dr. Ernest Jokl and Dr. C. G. Carroll have indicated the dangers of this activity. Arguments for interscholastic boxing are quite well reflected in the discussion presented.—*J. Grove Wolf.*

Psychology

42. JOHNSON, A. P. Notes on a suggested index of item validity: the U-L Index. *J. Educational Psychology* **42:** 499 (Dec. 1951).

The author suggests the U-L Index, which is a modification of the upper-lower twenty-seven per cent technique, as a simple and effective method for discriminating valid items.

The method is recommended because it is based on a technique of demonstrated effectiveness, because the calculations have been simplified, and because its level of significance may be readily approximated.—*Marjorie Phillips.*

Guide to Authors

IN LINE with the overall goal of making Association publications yield the greatest value to the individual and profession, the following is a yardstick for the preparation of research manuscripts. The information as spelled out below recognizes general techniques being employed by research publications of similar nature. Copy prepared on this basis looks forward to the establishment of a standard style for all Association research studies.

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Manuscripts should be sent to the Editor who will see that each one is read by at least three members of the Board of Associate Editors. The Editor will advise the author as to the suitability of the paper or the desirability for revision. Papers are not judged by arbitrary standards of length but on their content of new research results in the field of physical education, health education, and recreation, presented with the greatest brevity compatible with scientific accuracy and clarity.

Since three members of the Board of Associate Editors review an article it is requested that three copies of the manuscript (the original and two clear carbons) be submitted in order to facilitate reviewing. One copy of the article should be retained by the author for checking against galley proofs. However, only one copy of any charts, photographs, drawings, graphs, or similar illustrative material need be submitted. They will be sent to each reviewer in turn.

Typewritten manuscript should be double spaced on white paper of ordinary weight and standard size ($8\frac{1}{2}$ x 11 inches).

The sheets of manuscript should be kept flat and fastened with clips which can be removed easily. The pages of the typewritten copy should be numbered consecutively in the upper right hand corner.

Paragraphs should be numbered consecutively throughout the manuscript, to facilitate ease of reference in case of revisions.

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A uniform style should be maintained in writing citations. Do not enclose titles of chapters and articles in quotation marks. Italicize [underscore] names of books and publications. (See example below.)

A uniform sequence of data should be observed. The preferred sequence is: Author's name—title of article or chapter—name of book or publication—volume number—page numbers—year date.

EXAMPLE OF FOOTNOTE

[3] H. Harrison Clarke. *The Application of Measurement to Health and Physical Education.* New York: Prentice-Hall, Inc., 1946. p. 240.

EXAMPLES OF REFERENCES APPEARING AT END OF ARTICLE

1. DEAVER, G. G. Exercise and heart disease. *Research Quarterly*, **26**:24–34, 1939. (periodicals)
2. OGDEN, JEAN, AND JESS OGDEN. *Small Communities in Action.* New York, City: Harper & Brothers, 1946. (books)
3. POTTER, JOHN NICHOLAS. *Physical Fitness of Junior High School Boys.* Unpublished master's thesis, University of California, Berkeley, 1942. 39 pp.

Use of Numbers

Use figures for all definite weights, measurements, percentages, and degrees of temperature (for example: 2 kgm., 1 inch, 20.5 cc., 300°C.). Spell out all indefinite and approximate periods of time and other numerals which are used in a general sense (for example: one hundred years ago, about two-and-one-half hours, seven times). Spell out numbers through ten; Arabic figures for 11 and over.

Abbreviations

The metric system being in universal usage, standard abbreviations should be used whenever the weights and measurements are used with figures, i.e., 10 kgm., 6.25 cc., etc. The forms to be used are: cc., kgm., mgm., mm., l., and m. *Gram* should be spelled out in all cases to avoid possible confusion with

grain. All obscure and ambiguous abbreviations should be avoided. No abbreviations of English weights and measures should be used. Preserve uniformity in all abbreviations.

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Each table should have a descriptive heading and should be specifically referred to in the text by number, *e.g.*, "Table 10," etc., never as "the above table" or "the following table." Number tables from 1 up for the entire manuscript, using Arabic numerals. For graphic presentations, use Roman numerals. Per cent should be two words. Use per cent sign (%) in table or when it appears in parenthesis in text.

Never single space any tabular material.

Headings

Arrange article so as to indicate relative values of heading and subheadings. Usually four gradations are sufficient (a) article title, (b) first subhead appearing in boldface aligned left on page, (c) second subhead (if necessary) appearing in small caps aligned left on page, (d) third subhead, to appear in italic (underscored in manuscript), not centered, but run in at the beginning of the paragraph or section.

Illustrations

Illustrative material is of two types: pen and ink drawings, which are reproduced by the line engraving process; and photographs, wash drawings, stipple drawings, in short anything containing shading, which are reproduced by the halftone process.

Line engravings are always treated as text figures and should be so designated. All drawings should be made with India ink, preferably on white tracing paper or cloth. If co-ordinate paper is used, a blue-lined paper must be chosen, as all other colors blur on reproduction; sometimes it is desirable to ink in inch squares so that the curves can be more easily read.

Lettering should be plain and large enough to reproduce well when the drawing is reduced to the dimensions of the printed page ($4\frac{1}{8}$ x 7 inches). Most figures can be advantageously drawn for a linear reduction of one-half or one-fourth. Co-ordinate lettering should be included within the chart. Do not use gummed letters, for they are easily lost.

Care should be taken not to waste space, as this means greater reduction and a less satisfactory illustration. Often it is possible to combine several curves in one figure and thus not only save space but enable the reader to make comparisons at a glance. Legends can often be included within the chart and a considerable saving in space thus effected.

Halftones are treated as plates and should be so designated. Frequently, several halftones can be grouped to form an attractive full page plate, in which case they should be numbered consecutively, in Arabic numerals, as figures of the plate. Photographs should be in the form of clear black and white prints

on glossy paper. Care should be taken to see that they cannot be bent or folded in handling *and paper clips should not be used.* All imperfections in the original copy are reproduced.

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Be sure to answer all queries on the proof. Write any instructions to the printer on the proof itself. (If instructions are written on separate sheets the parcel will require first class postage; if instructions are too extensive to write on proof, embody them in a letter and send separately.) Draw ring around instructions and answers to queries to avoid possibility of mistaking them for new copy. Return proof to the Editor.